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NATIONAL DAM SAFETY PROGRAM. SCHILLER POND DAM (NJ00153), DELAWARE-ETC(U)
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DELAWARE RIVER BASIN
TRIBUTARY ALEXAUKEN CREEK,
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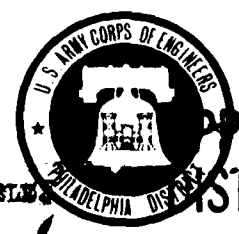
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PHASE 1 INSPECTION REPORT NATIONAL DAM SAFETY PROGRAM



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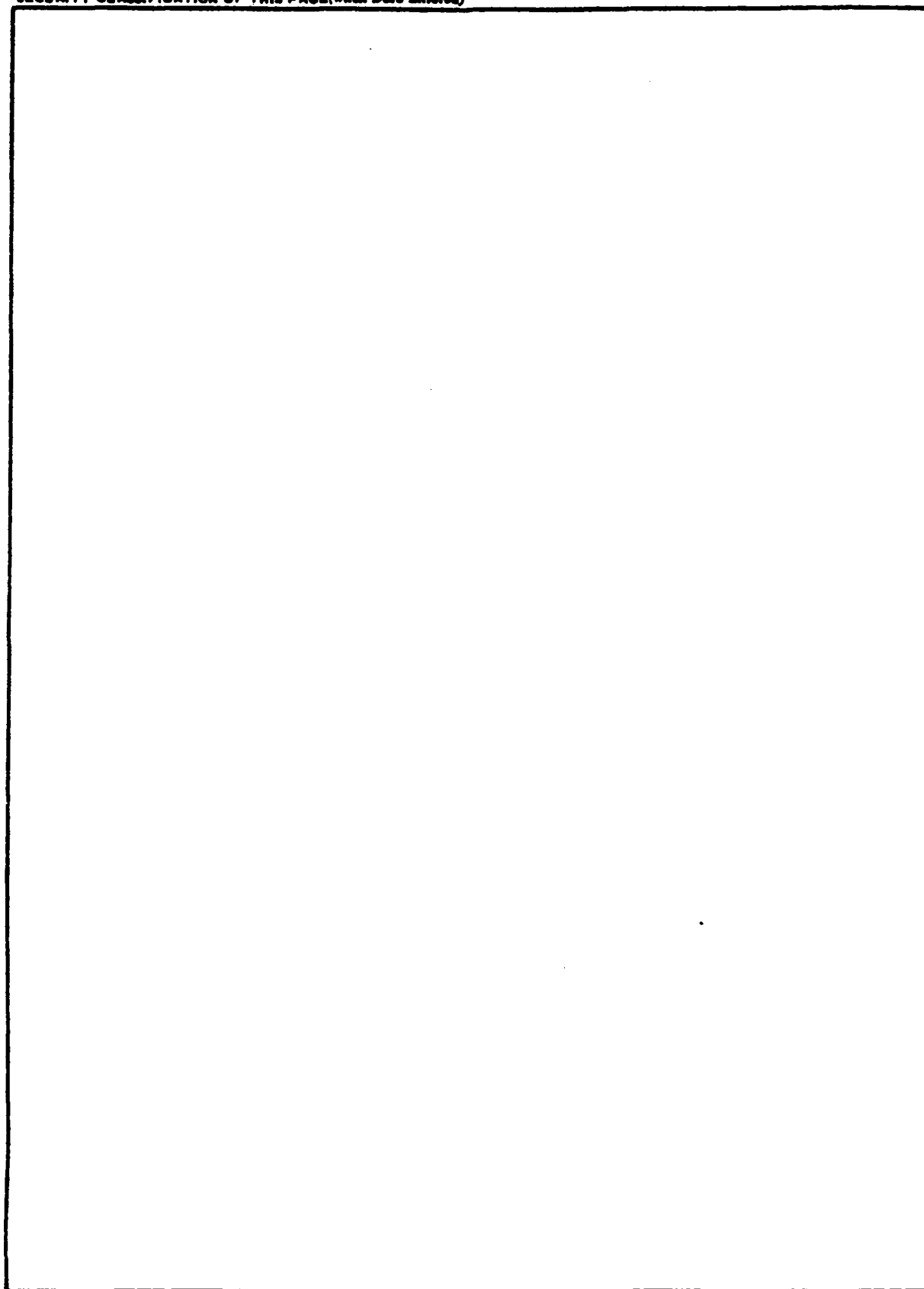
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20. ABSTRACT (Continue on reverse side if necessary and identify by block number) This report cites results of a technical investigation as to the dam's adequacy. The inspection and evaluation of the dam is as prescribed by the National Dam Inspection Act, Public Law 92-367. The technical investigation includes visual inspection, review of available design and construction records, and preliminary structural and hydraulic and hydrologic calculations, as applicable. An assessment of the dam's general condition is included in the report.		

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Honorable Brendan T. Byrne
Governor of New Jersey
Trenton, New Jersey 08611

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Dear Governor Byrne:

Enclosed is the Phase I Inspection Report for Deer Head Lake Dam in Ocean County, New Jersey which has been prepared under authorization of the Dam Inspection Act, Public Law 92-567. A brief assessment of the dam's condition is given in the front of the report.

Based on visual inspection, available records, calculations and past operational performance, Deer Head Lake Dam, a brick masonry potential structure, is judged to be in good overall condition. The dam's spillways are considered inadequate because a flow equivalent to eight percent of the Spillway Design Flood - SDF - would cause the dam to be overtopped. (The SDF, in this instance, is one half of the Probable Maximum Flood). The decision to consider the spillways "inadequate" instead of "seriously inadequate" is based on the determination that dam failure resulting from overtopping would not significantly increase the hazard to loss of life downstream from the dam from that which would exist just before overtopping failure. To ensure adequacy of the structure, the following actions, as a minimum, are recommended:

a. The spillways' adequacy should be determined by a qualified professional consultant engaged by the owner using more sophisticated methods, procedures and studies within six months from the date of approval of this report. Within three months of the consultant's findings remedial measures to ensure spillway adequacy should be initiated. In the interim, a detailed emergency operation plan and warning system should be promptly developed. Also, during periods of unusually heavy precipitation, around the clock surveillance should be provided.

b. Within twelve months from the date of approval of this report, the following remedial actions should be completed:

- (1) Repair the stilling basin of the left spillway with epoxy cement.

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9. Additional copies of this report may be obtained from the National Technical Information Service (NTIS), Springfield, Virginia, 22161 at a reasonable cost. Please allow four to six weeks from the date of this letter for NTIS to have copies of the report available.

10. An important aspect of the Dam Inspection Program will be the implementation of the recommendations made as a result of the inspection. We accordingly request that we be advised of proposed action taken by the State to implement the recommendations.

11. Other copies

Richard H. Benson

Richard H. Benson

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DELAWARE RIVER BASIN
TRIBUTARY ALEXAUKEN CREEK, HUNTERDON COUNTY
NEW JERSEY

SCHILLER POND DAM

(NJOC153)

PHASE I INSPECTION REPORT
NATIONAL DAM SAFETY PROGRAM

DEPARTMENT OF THE ARMY
PHILADELPHIA DISTRICT, CORPS OF ENGINEERS
PHILADELPHIA, PENNSYLVANIA 19106

MAY, 1981

PHASE I INSPECTION REPORT
NATIONAL DAM SAFETY PROGRAM

Name: Schiller Pond Dam, I.D. NJ 00153
State Located: New Jersey
County Located: Hunterdon County
Stream: Tributary Alexanken Creek
River Basin: Delaware River
Date of Inspection: January 13, and February 3, 1981

Assessment of General Conditions

Schiller Pond Dam is an earthfill dam with a concrete drop inlet, the main spillway, in the center of the dam. In addition there is an auxiliary spillway at the right end of the dam. The overall condition of the dam is good. There are no signs of distress or instability in the embankment. The downstream channel is well defined and in good condition. The low-level outlet was not opened and is not used. The hazard potential is rated as "high".

Schiller Pond Dam is considered inadequate in view of its lack of spillway capacity to pass the SDF (1/2 PMF) without overtopping the dam. The spillway is capable of passing a flood equal to 35 percent of the PMF (70 percent of the 1/2 PMF), and is assessed as "inadequate".

At present, the engineering data available is not sufficient to make a definitive statement on the stability of the dam, but based on the findings of the visual inspection, the preliminary assessment of static stability is that it is satisfactory. The following actions are recommended along with a timetable for their completion. All recommended actions should be conducted under the supervision of an Engineer who is experienced in the design, construction and inspection of dams.

1. Carry out a more precise hydrologic and hydraulic analysis of the dam within twelve months, to determine the need and type of mitigating measures necessary. Based on the results of these studies, remedial measures should be instituted. This should include the installation of a tailwater gage.
2. Construct a concrete headwall and apron at the outlet end of the discharge pipe within twelve months.

3. The trees should be removed from the embankment slopes to avoid problems that may develop from roots. The area should then be seeded to develop a growth of grass for surface erosion protection. This should be done within twelve months.
4. Determine if the low-level outlet gate is operable, and if not institute remedial action to make it operable within twelve months.
5. The owner should develop an emergency action plan (if one is not already available) outlining actions to be taken by the operator to minimize downstream effects of an emergency and establish a flood warning system for the downstream communities within three months.

Furthermore, while of a less urgent nature, the following additional action is recommended and should be carried out within twelve months.

The owner should develop, within one (1) year after formal approval of the report, written operating procedures and a periodic maintenance plan to insure the safety of the dam.



John P. Talerico, P.E.
HARRIS-ECI ASSOCIATES



Photo taken January 13, 1981

SCHILLER POND DAM

View of dam looking towards the auxiliary spillway.
Main spillway is drop inlet in right center of photo.

PREFACE

This report is prepared under guidance contained in the Recommended Guidelines for Safety Inspection of Dams, for Phase I Investigations. Copies of these guidelines may be obtained from the office of the Chief of Engineers, Washington, D.C. 20314. The purpose of a Phase I Investigation is to identify expeditiously those dams which may pose hazards to human life or property. The assessment of the general condition of the dam is based upon available data and visual inspections. Detailed investigation, and analyses involving topographic mapping, subsurface investigations, testing, and detailed computational evaluations are beyond the scope of a Phase I investigation; however, the investigation intended to identify any need for such studies.

In reviewing this report, it should be realized that the reported condition of the dam is based on observations of field conditions at the time of inspection along with data available to the inspection team. It is important to note that the condition of a dam depends on numerous and constantly changing internal and external conditions, and is evolutionary in nature. It would be incorrect to assume that the present condition of the dam will continue to represent the condition of the dam at some point in the future. Only through continued care and inspection can there be any chance that unsafe conditions be detected.

Phase I inspections are not intended to provide detailed hydrologic and hydraulic analyses. In accordance with the established Guidelines, the Spillway Test flood is based on the estimated "Probable Maximum Flood" for the region (greatest reasonably possible storm runoff), or fractions thereof. The test flood provides a measure of relative spillway capacity and serves as an aide in determining the need for more detailed hydrologic and hydraulic studies, considering the size of the dam, its general condition and the downstream damage potential.

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PHASE I INSPECTION REPORT
NATIONAL DAM SAFETY PROGRAM

SCHILLER POND DAM, I.D. NJ 00153

S E C T I O N 1

1. PROJECT INFORMATION

1.1 General

a. Authority

The National Dam Inspection Act (Public Law 92-367, 1972) provides for the National Inventory and Inspection Program by the U.S. Army Corps of Engineers. This inspection was made in accordance with this authority under Contract C-FPM No. 35 with the State of New Jersey who, in turn, is contracted to the Philadelphia District of the Corps of Engineers, and was carried out by the engineering firm of Harris-ECI Associates of Woodbridge, New Jersey.

b. Purpose of Inspection

The visual inspection of Schiller Pond Dam was made on January 13 and February 3, 1981. The purpose of the inspection was to make a general assessment as to the structural integrity and operational adequacy of the dam embankment and its appurtenant structures.

c. Scope of Report

The report summarizes available pertinent data relating to the project; presents a summary of visual observations made during the field inspection; presents an evaluation of hydrologic and hydraulic conditions at the site; presents an evaluation as to the structural adequacy of the various project features; and assesses the general condition of the dam with respect to safety.

1.2 Description of Project

a. Description of Dam and Appurtenances

Schiller Pond Dam is an earthfill dam approximately 300 feet long and 18.5 feet high with a clay cut off trench. There are two spillways, an 8-foot by 6 foot concrete drop inlet which is the main spillway and a 60 foot wide grass covered auxiliary spillway. The auxiliary spillway, which was construct by excavating the existing ground, is located at the right end of the dam. Its crest is 4.0 feet below the top of the embankment. The drop inlet is located approximately 150 feet from the left edge of the auxiliary spillway and its crest is 6.5 feet below the top of the embankment. There is a wire screen on top of the inlet to keep the trout from going into the discharge during high pond levels. The flow from the drop inlet discharges into the downstream channel through a 72-inch corrugated metal pipe, which has two anti-seep collars extending three feet beyond the outside of the pipe. The flow from the auxiliary spillway runs perpendicular to the dam along the discharge channel for approximately 80 feet and then flows to the left along the existing ground to the downstream channel.

The embankment has a top width of 10 feet with a 3H:1V slope on the upstream face and approximately a 4H:1V slope on the downstream face.

The low-level outlet consists of a 72-inch corrugated metal pipe that carries the flow from the main spillway. The low-level flow into the pipe is controlled by a 18-inch valve located on the upstream wall of the inlet. The valve is operated manually by a removable hand crank that fits into a small iron pipe attached to the face of the inlet.

The outlet end of the pipe discharges into the downstream channel approximately 80 feet from the inlet. The channel starts at the discharge outlet and continues downstream for a distance of 600 feet where it crosses under the Rocktown-Lambertville Road through a 14 foot x 8 foot opening.

A generalized description of the soil conditions is contained in Report No. 6, Hunterdon County, Engineering Soil Survey of New Jersey, by Rutgers University. The report dated 1952, indicates the area of the dam and pond to be stratified recent alluvium, with the surrounding area being diabase bedrock.

Recent alluvium can be described as materials usually assorted by water action and ranging in size from silt with some clay, to silt and fine sand with gravel. Diabase is described as hard, non-homogeneous rock commonly identified as trap rock with variable overlaying depths of silts and silty clays with frequent gravelly phases. Geologic Overlay Sheet 27 classifies the underlying rock as diabase

b. Location

Schiller Pond Dam is located on a tributary of Alexauken Creek, in the Township of West Amwell, Hunterdon County, New Jersey. The dam is accessible from Route 179 at Mount Airy by way of Mill Road to Rocktown-Lambertville Road.

c. Size Classification

According to the "Recommended Guidelines for Safety Inspection of Dams" by the U.S. Department of the Army, Office of the Chief Engineers, the dam is classified in the dam size category as being "small", since its storage volume of 73 acre-feet is less than 1,000 acre-feet. The dam is also classified as "small" because its height of 18.5 feet is less than 40 feet. The overall size classification of Schiller Pond Dam is "small".

d. Hazard Classification

A hazard potential classification of "high" was assigned to Schiller Pond Dam on the basis that there are more than a dozen homes located on both sides of the stream downstream of the Rocktown-Lambertville Road. Therefore the possibility exists of the loss of more than a few lives in the event of a hypothetical failure of the dam.

e. Ownership

Schiller Pond Dam is owned by:

Mr. William Schiller
R.D.I., Box 350
Hopewell, NJ 08525
(609) 466-1687

f. Purpose

Schiller Pond Dam was originally constructed for irrigation but is presently used for recreational purposes only. The pond is stocked every year with trout by a fishing club.

g. Design and Construction History

Schiller Pond Dam was designed by the U.S. Soil Conservation Service. The permit to construct the dam was issued on September 3, 1959 with the dam being completed in November 1960.

h. Normal Operating Procedures

The discharge from the lake is unregulated and allowed to naturally balance the inflow into the lake. According to the owner the low-level outlet is not used due to the pond being heavily stocked with trout.

1.3 Pertinent Data

a. Drainage Area

1.37 sq. mi.

b. Discharge at Dam Site

Ungated spillway capacity at
elevation of top of dam: 2,207 (311.50 NGVD)

Total spillway capacity at
maximum pool elevation (SDF): 3,324 (312.3 NGVD)

c. Elevation (Feet above NGVD)

Top of dam: 311.5

Maximum pool design surcharge (SDF): 312.3

Recreation pool: 305

Spillway crest: Main: 305
Auxiliary: 307.5

Streambed at centerline of dam: 293 (Estimated)

Maximum tailwater: 296 (Estimated)

d. Reservoir

Length of maximum pool: 1,900 ft. (Estimated)

Length of recreation pool: 1,200 ft. (Estimated)

e. Storage (acre-feet)

Spillway Crest: 18

Top of dam: 73

Maximum pool (SDF): 83

f. Reservoir Surface (acres)

Top of dam: 11.5 (Estimated)

Maximum pool (SDF): 11.6 (Estimated)

Recreation pool: 5.5

Spillway crest: 5.5 (305 NGVD)

g. Dam

Type:	Earthfill with concrete drop inlet
Length:	220 ft. (Effective)
Height:	18.5 ft.
Top width:	10 ft.
Side slopes - Upstream:	3H:1V
- Downstream:	4H:1V
Zoning:	Unknown
Impervious core:	None
Cutoff:	200 ft. clay cut-off
Grout curtain:	None

h. Diversion and Regulating Tunnel

i. Spillway

Type:	Main:	Concrete drop inlet
	Auxiliary:	Earth Channel
Length of weir:	Main:	28 ft.
	Auxiliary:	60 ft.
Crest elevation:	Main:	305 NGVD
	Auxiliary:	307.5 NGVD
Gates:		
U/S Channel:		Schiller Pond
	Main:	Natural Channel
D/S Channel:	Auxiliary:	Existing ground.

j. Regulating Outlets

Low level outlet:	72-inch C.M.P.
Controls:	Manually controlled 18-inch valve.
Emergency gate:	None
Outlet:	294. NGVD

SECTION 2

2. ENGINEERING DATA

2.1 Design

Drawings and specifications for the construction of the Schiller Pond Dam are available in the files of NJ Department of Environmental Protection (NJ-DEP) in Trenton and also at the offices of the U.S. Department of Agriculture - Soil Conservation Service (SCS) in Somerset N.J. The structural design data of the spillway as well as the hydrology and hydraulic data for 25-year and 50-year design storm is available at the above locations. One drawing shows the location of and data obtained from tests pits taken along the dam. Soil test results, design computations and other geotechnical data needed to assess the stability properly are not available.

2.2 Construction

Data is not available concerning the as-built construction of the dam. No data exists of construction methods, borrow sources or other data pertinent to the construction of the dam.

2.3 Operation

Formal operation records are not kept for the dam and reservoir. The pond is allowed to operate naturally without regulation.

2.4 Evaluation

a. Availability

The availability of engineering data is good. The construction plans and specifications for the dam are available from the NJ-DEP and the SCS.

b. Adequacy

The engineering data available from the plans and from the field was adequate to perform hydrologic and hydraulic computations. The data was insufficient to perform stability analysis, but a preliminary evaluation could be made based on visual observations.

c. Validity

The information contained in the drawings and checked by limited field measurements appears to be valid except downstream slope of the embankment measured 4H:1V instead of 2H:1V as shown on the plans.

SECTION 3

3. VISUAL INSPECTION

3.1 Findings

a. General

The visual inspection of Schiller Pond Dam revealed the dam and spillways to be in good condition. At the time of the inspection the pond level was just above the crest of the main spillway.

b. Dam

The earth embankment appears sound. No surface cracking on the embankment or at the toe was noticed. No sloughing or erosion of the embankment was observed. The vertical and horizontal alignments of the crest are good. A group of four evergreen trees are growing on the embankment at the junction with the left end of the auxiliary spillway. There is also one small tree growing at the water's edge left of the main spillway. No evidence of burrowing by animals was observed.

c. Appurtenant Structures

1. Spillways

The main spillway is a concrete drop inlet with an 18-inch valve. Wire fencing supported by iron pipes covers the top of the inlet to prevent the trout from going through the discharge pipe during high pond levels. The inlet is in good condition. The auxiliary spillway is grass covered and in good condition. Horizontal and vertical alignments of the auxiliary spillway are good.

2. Outlet Works

The low-level outlet works is also the main spillway. It consists of a drop inlet with a 18-inch valve attached to the front face of the inlet, and a 72-inch corrugated metal pipe that carries the flow to the downstream channel. The valve is operated by a removable hand crank. The outlet is in good condition. There is no headwall at the outlet end of the pipe. The riprap slope along the sides of the pipe is missing.

There is some minor slope erosion along the sides of the pipe, and immediatley downstream along the right bank.

d. Reservoir Area

The reservoir's side slopes are flat to moderate. There are some trees along the left shore line and a evergreen nursery on the back slope. Lakeside Road runs along the right shoreline. There is no indication of slope instability.

e. Downstream Channel

The downstream channel is in good condition. It is a well defined channel that starts at the outlet and then parallels Lakeside Road until it crosses under the Rocktown-Lambertville Road 600 feet downstream. The banks are wooded and shallow with the surrounding area relatively flat. Downstream of Rocktown-Lambertville Road there are houses on both sides of the stream.

SECTION 4

4. OPERATIONAL PROCEDURES

4.1 Procedures

Schiller Pond Dam is used to impound water for recreational activities. The level of the lake is maintained through the unregulated flow over the spillway.

4.2 Maintenance of the Dam

There is no regular inspection and maintenance program for the dam and appurtenant structures. Mr. William Schiller is responsible for the maintenance of the dam.

4.3 Maintenance of Operating Facilities

The low-level outlet operating facilities consist of the one manually operated 18-inch valve. Operation of the valve was not satisfactorily demonstrated as the hand crank was not available.

4.4 Evaluation

The present operational and maintenance procedures are fair with the dam and spillway being maintained in a serviceable condition.

SECTION 5

5. HYDRAULIC/HYDROLOGIC

5.1 Evaluation of Features

a. Design

The drainage area above Schiller Pond Dam is approximately 1.37 square miles. A drainage map of the water shed of the dam site is presented on Plate 1, Appendix D.

The topography within the basin is generally moderately sloped. Elevations range from approximately 473 feet above NGVD at the northwest end of the watershed to about 305 feet at the dam site. Land use patterns within the watershed are mostly woodland.

The evaluation of the hydraulic and hydrologic features of the dam was based on criteria set forth in the Corps guidelines and additional guidance provided by the Philadelphia District, Corps of Engineers. The SDF for the Dam falls in a range of 1/2 PMF to PMF. In this case, the low end of the range, 1/2 PMF, is chosen since the factors used to select size and hazard classification are on the low-side of their respective ranges.

The Probable Maximum Flood (PMF) was calculated from the probable maximum precipitation using Hydrometeorological Report No. 33 with standard reduction factors. Due to the small drainage area, the SCS triangular hydrograph transformed to a curvilinear hydrograph was adopted for developing the unit hydrograph, with the aid of the HEC-1-DB Flood Hydrograph Computer Program.

Initial and constant infiltration loss rates were applied to the Probable Maximum Precipitation to obtain rainfall excesses. The rainfall excesses were applied to the unit hydrograph to obtain the PMF and various ratios of PMF utilizing program HEC-1-DB.

The SDF peak outflow calculated for the dam is 3,324 cfs. This value is derived from the half PMF, and results in overtopping of the dam, assuming that the lake was originally at the spillway crest elevation.

The stage-outflow relation for the spillway was determined from the geometry of the spillway and dam utilizing HEC-1 Dam Safety Version program.

The reservoir stage-storage capacity relationship was computed directly by the conic method, utilizing the HEC-1-DB program. The reservoir surface areas at various elevations were measured by planimeter from a U.S.G.S. Quadrangle topographic map. Reservoir storage capacity included surcharge levels exceeding the top of the dam, and the spillway rating curve was based

on the assumption that the dam remains intact during routing. The spillway rating curve is presented in the Hydrologic Computation, Appendix D.

A breach analysis indicates that the stage of the stream where it crosses Rocktown-Lambertville Road is 0.6 feet higher, due to dam failure from overtopping at 0.4 PMF than it would be without failure at 0.4 PMF. This is likely not to jeopardize the well traveled road downstream significantly more than without failure. The discharge facility is thus rated "inadequate".

Drawdown calculations indicate that to empty the lake to an elevation of 299.5 NGVD through the one low-level outlet would take 20 hours, assuming a 2 cfs/square mile inflow. This is not considered to be an excessive drawdown period, and provision of additional outlets should not be considered.

b. Experience Data

No records of reservoir stage or spillway discharges are maintained for this site.

c. Visual Observation

The downstream channel is in good condition. It parallels Lakeside Road until the channel crosses under Rocktown-Lambertville Road 600 feet downstream of the dam. The banks are shallow and wooded. Downstream of Rocktown-Lambertville Road, there are houses on both sides of the stream.

The side slopes of the reservoir are flat to moderate with no signs of instability. The drainage area is primarily wooded and undeveloped.

d. Overtopping Potential

A storm of magnitude equivalent to the SDF would cause overtopping of the dam to a height of 0.8 feet. Computations indicate that the dam can pass approximately 35 percent of the PMF without overtopping the dam crest. Since the 1/2 PMF is the Spillway Design Flood (SDF) for this dam, according to the Recommended Guidelines for Safety Inspection of Dams by the Corps of Engineers, the spillway capacity of the dam is assessed as "inadequate".

SECTION 6

6. STRUCTURAL STABILITY

6.1 Evaluation of Structural Stability

a. Visual Observations

There are no signs of distress in the embankment of the Schiller Pond Dam. The trees growing on the embankment at the junction with the auxiliary spillway could pose a threat to stability. The spillways are in good condition.

b. Design and Construction Data

No design computations relating to stability were uncovered during the report preparation phase. No embankment or foundation soil parameters are available for carrying out a conventional stability analysis of the embankment.

c. Operating Records

No operating records are available relating to the stability of the dam.

d. Post-Construction Changes

There are no known post-construction changes since the dam was built in 1960.

e. Static Stability

A static stability analysis was not performed for Schiller Pond Dam because the lack of data on which to base assumptions of material properties within embankment zones might produce misleading results, but based on the findings of the visual inspection, the preliminary assessment of static stability is that it is satisfactory.

f. Seismic Stability

The dam is located in Seismic Zone 1, as defined in Recommended Guidelines for Safety Inspection of Dams, prepared by the Corps of Engineers. In general, projects located in Seismic Zones 0, 1 and 2 may be assumed to present no hazard from earthquake, provided the static stability conditions are satisfactory and conventional safety margins exist, and based on the findings of the visual inspection, the preliminary assessment of the static and seismic stabilities is that they are satisfactory.

SECTION 7

7. ASSESSMENT/REMEDIAL MEASURES

7.1 Dam Assessment

a. Safety

The dam has been inspected visually and a review has been made of the available engineering data. This assessment is subject to the limitations inherent in the visual inspection procedures stipulated by the Corps of Engineers for a Phase I report.

Schiller Pond Dam is inadequate because the dam does not have the spillway capacity to pass the SDF, one half of the PMF, without overtopping. Overtopping of the dam carries with it the danger of a likely progressive failure of the dam. The present spillway capacity of the dam is approximately 35 percent of the PMF.

No definitive statement pertaining to the safety of the embankment can be made without acquisition of embankment material engineering properties, but based on the findings of the visual inspection, preliminary assessment of the static stability is that it is satisfactory.

b. Adequacy of Information

The information uncovered was adequate to perform hydrologic and hydraulic computations. The data was insufficient to perform even an approximate computation of the stability of the dam. A preliminary assessment of the dam could be made by visual observation only.

c. Urgency

The remedial measures and recommended actions along with a timetable for their completion are detailed below. All recommended action should be conducted under the supervision of an engineer who is experienced in the design, construction and inspection of dams.

7.2 Remedial Measures

a. Alternatives for Increasing Spillway Capacity

Alternatives for increasing spillway capacity are as follows:

1. Increase the embankment height of the dam thus permitting a higher discharge to pass.

2. Lower the spillway crest elevation.
3. Increase the effective spillway crest length.
4. A combination of any of the above alternatives.

b. Recommendations

1. Carry out a more precise hydrologic and hydraulic analysis of the dam within twelve months, to determine the need and type of mitigating measures necessary. If required, conduct a study of the means of increasing spillway discharge capacity and develop alternative schemes for construction. This should include the installation of headwater and tailwater gages. The ability of the dam to withstand overtopping should also be studied.
2. Construct a concrete headwall and apron at the outlet end of the discharge pipe within twelve months.
3. Remove the trees from the embankment slopes to avoid problems from roots. The area should then be seeded to develop a growth of grass for surface erosion protection. This should be done within twelve months.
4. Determine if the low-level outlet is operable, and if not institute remedial action to make it operable within twelve months.

The following additional action is recommended:

The owner should develop an emergency action plan (if one is not already available) outlining actions to be taken by the operator to minimize downstream effects of an emergency and establish a flood warning system for the downstream communities within three months.

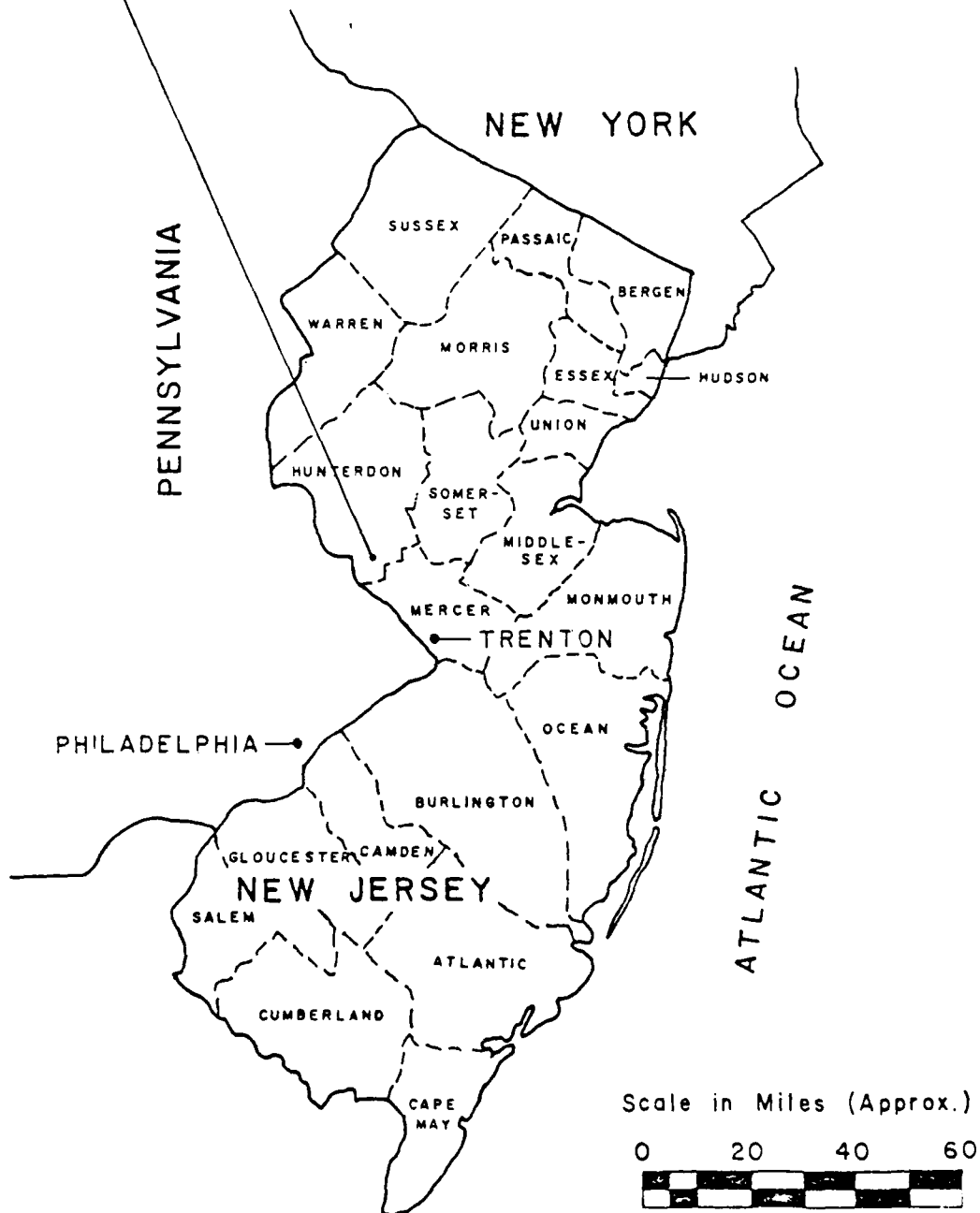
c. O & M Procedures

The owner should develop, within one (1) year after formal approval of the report, written operating procedures and a periodic maintenance plan to insure the safety of the dam.

P L A T E S .

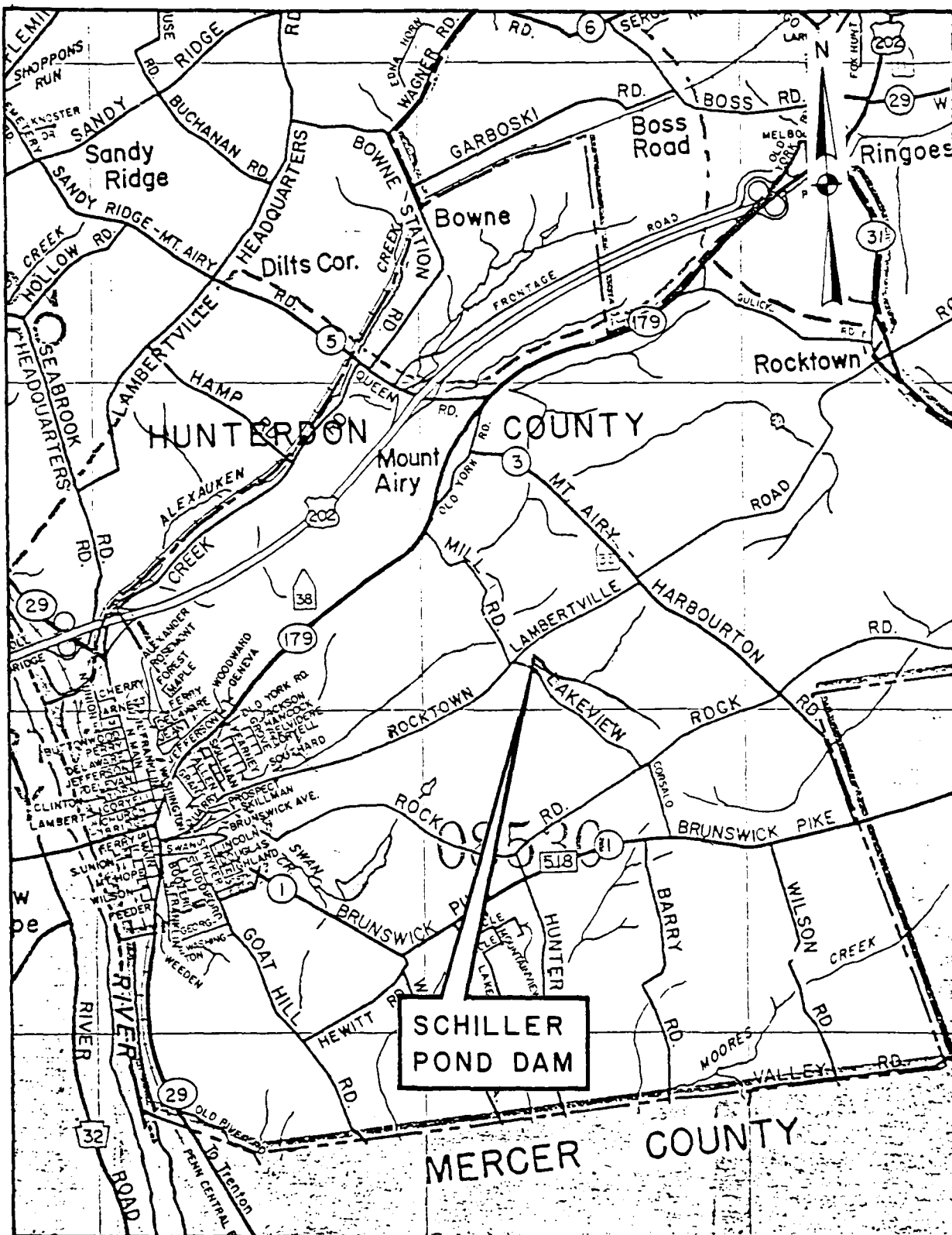
SCHILLER POND DAM

WEST AMWELL TWP.
HUNTERDON CO., N. J.



KEY MAP

PLATE I

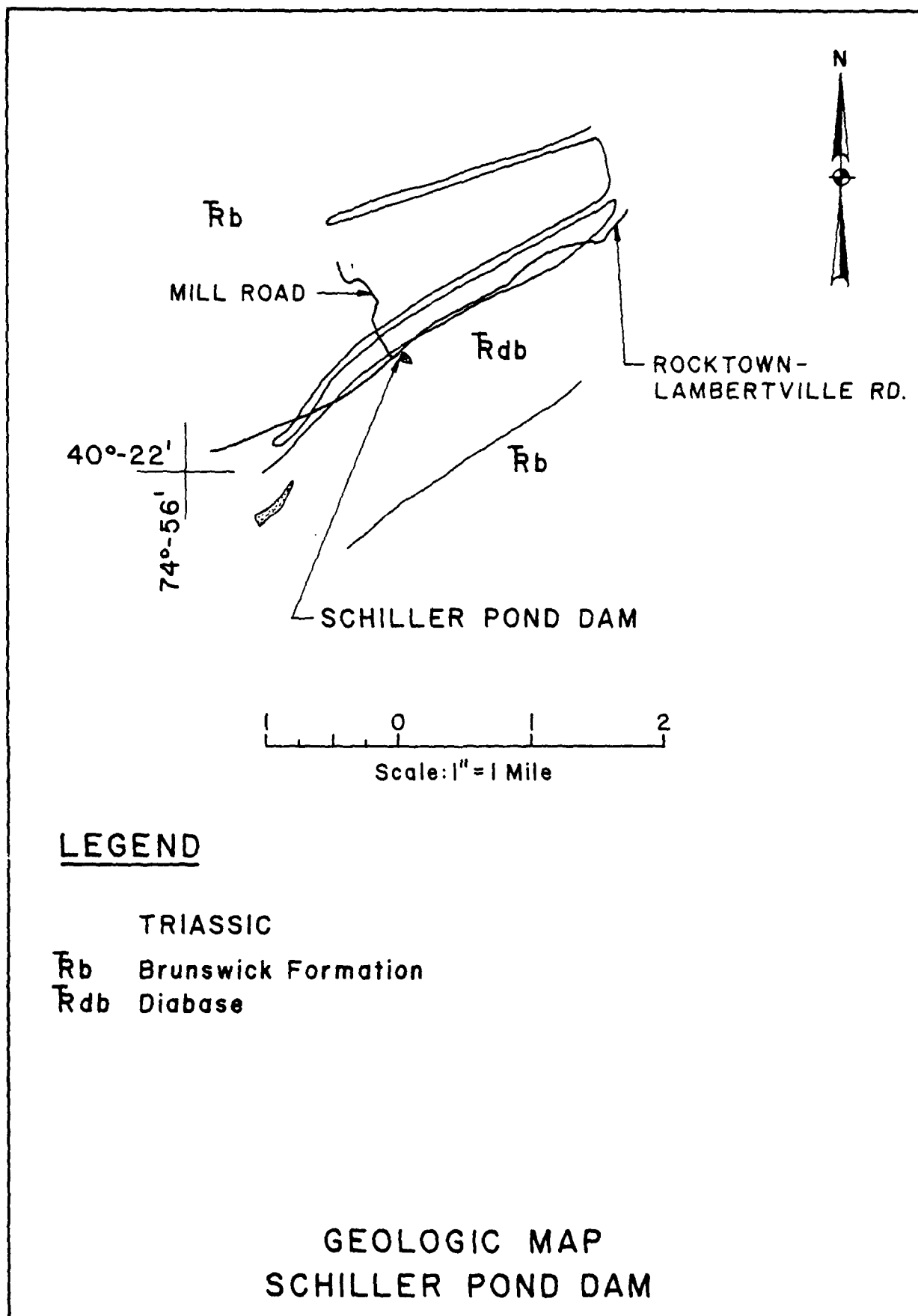


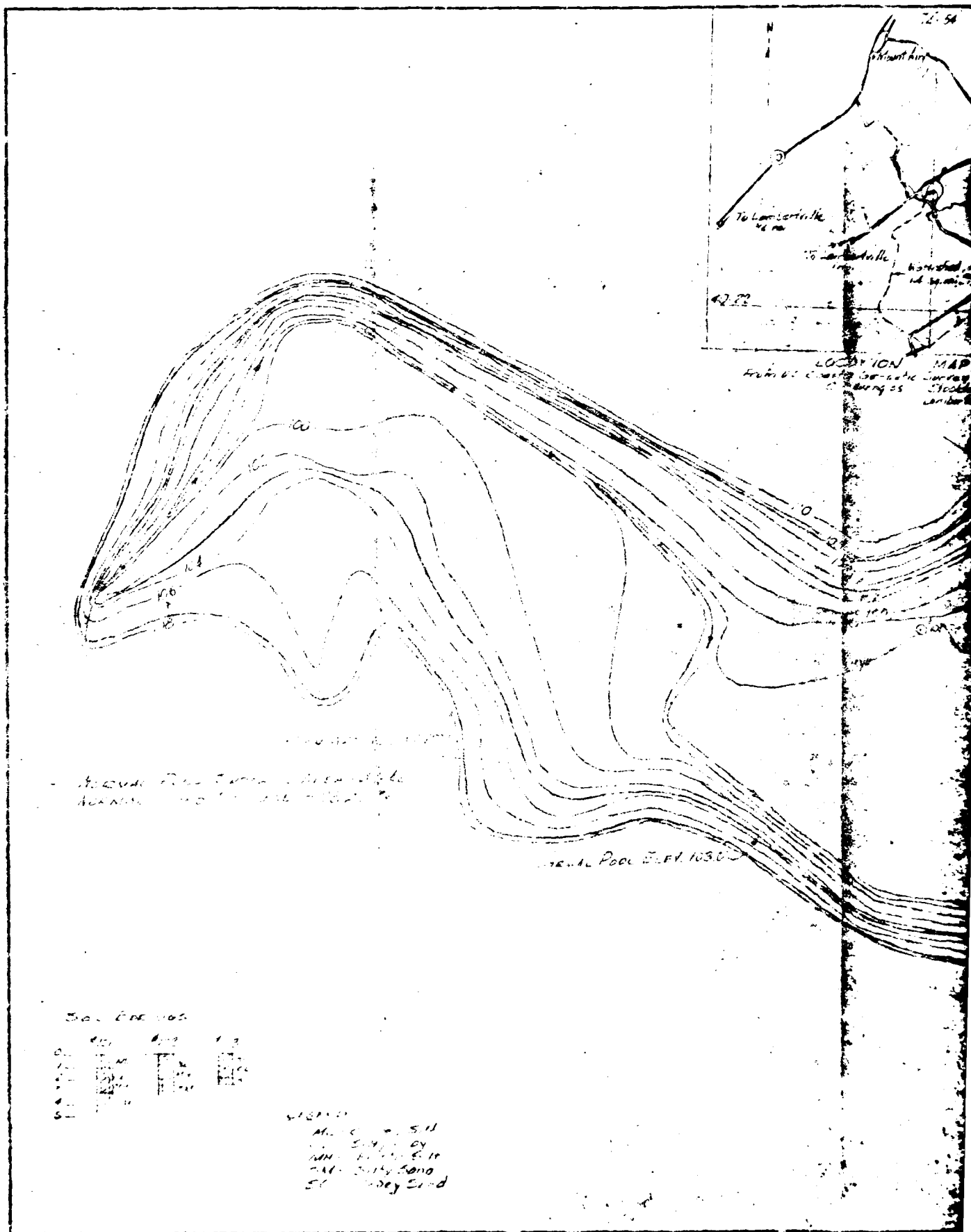
Scale in Miles (Approx.)

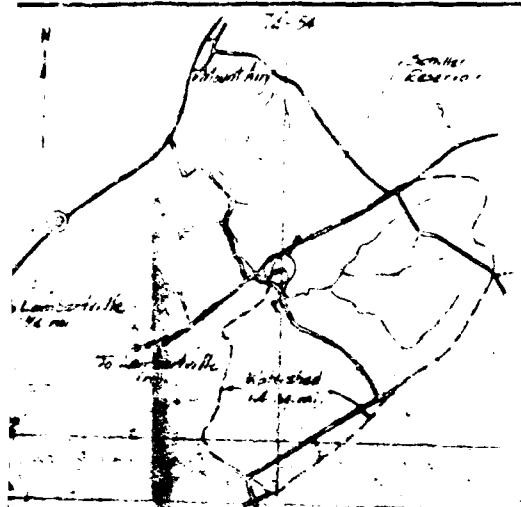


VICINITY MAP

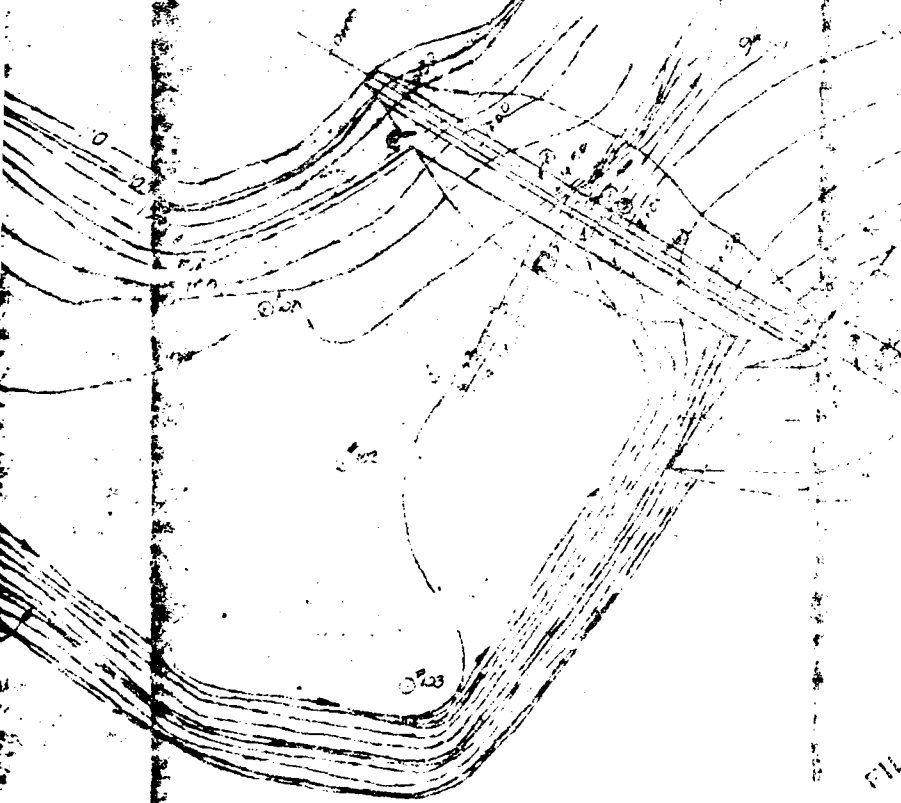
PLATE 2







LOCATION MAP
 From U.S. Coast & Geodetic Survey
 Chart 115
 Station 19 4 1. North S. W. 1/4 Sec. 17 N.
 Lambertville, Pa. 1/4 Sec. 17 N. 1/4 Sec. 17 E.



EM #1
 1.00' in center of structure
 headwater of Pennsylvania
 of 40' RC concrete dam and
 1.00' in center of dam

FILE

PAID BY THE STATE OF PENNSYLVANIA
 TO THE U.S. DEPARTMENT OF AGRICULTURE
 FOR THE SOIL CONSERVATION SERVICE

SEP 3 1932

W. H. Shicklin
 Attorney

DAM APPLICATION NO. 532

FILE

DAM APPLICATION NO. 532

U.S. DEPARTMENT OF AGRICULTURE SOIL CONSERVATION SERVICE	
Project Name Lambertville Dam	Project No. 532
Location Lambertville, Pa.	County Berks
Owner Lambertville Dam Co.	Engineer W. H. Shicklin
State Pennsylvania	Date Sept 3, 1932

Normal High ELEV. 1275

Low High ELEV. 1275

Vertical Scale
100
200
300
400
500
600
700
800
900
1000
1100
1200
1300
1400
1500
1600
1700
1800
1900
2000
2100
2200
2300
2400
2500
2600
2700
2800
2900
3000
3100
3200
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8300
8400
8500
8600
8700
8800
8900
9000
9100
9200
9300
9400
9500
9600
9700
9800
9900
10000

Grass
Trench

PROF LE ALONG

Normal High ELEV. 1275

Low High ELEV. 1275

Vertical Scale
100
200
300
400
500
600
700
800
900
1000
1100
1200
1300
1400
1500
1600
1700
1800
1900
2000
2100
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9900
10000

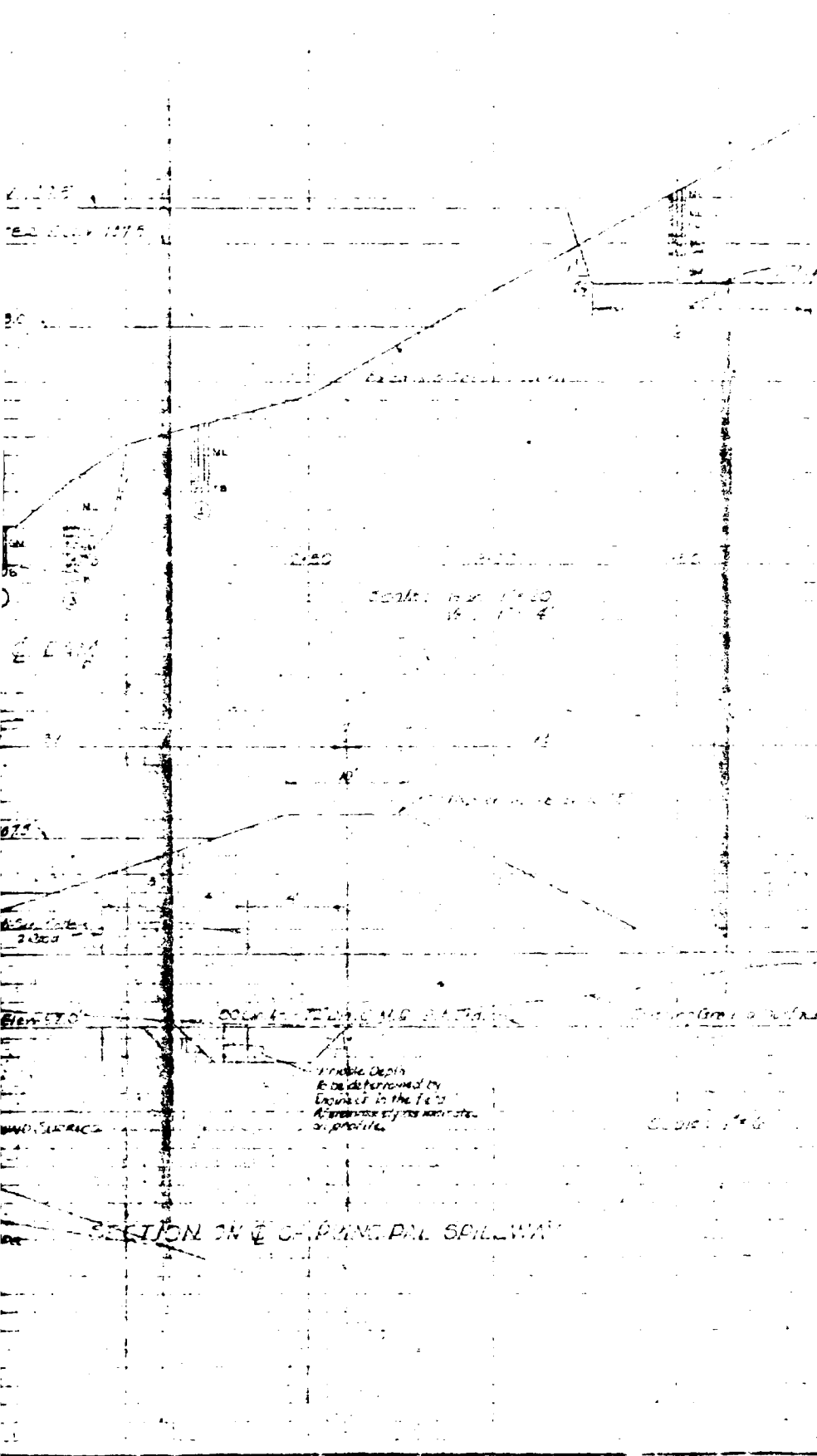
Grass
Trench

PROF LE ALONG

Normal High ELEV. 1275

Low High ELEV. 1275

SECTION OF CHANNEL



Legend - Soil Classification
 1. Clayey Silt
 2. Silty Clay
 3. Clayey Sand
 4. Silty Sand
 5. Sand
 6. Gravelly Sand
 7. Sandy Gravel
 8. Gravelly Gravel
 9. Gravel
 10. Cobble
 11. Boulders

FILE

EXAMINED BY N. H. ...
 AND ...
 ...
 APPROVED ...

DAM APPLICATION No. 632

DAM APPLICATION No. 632

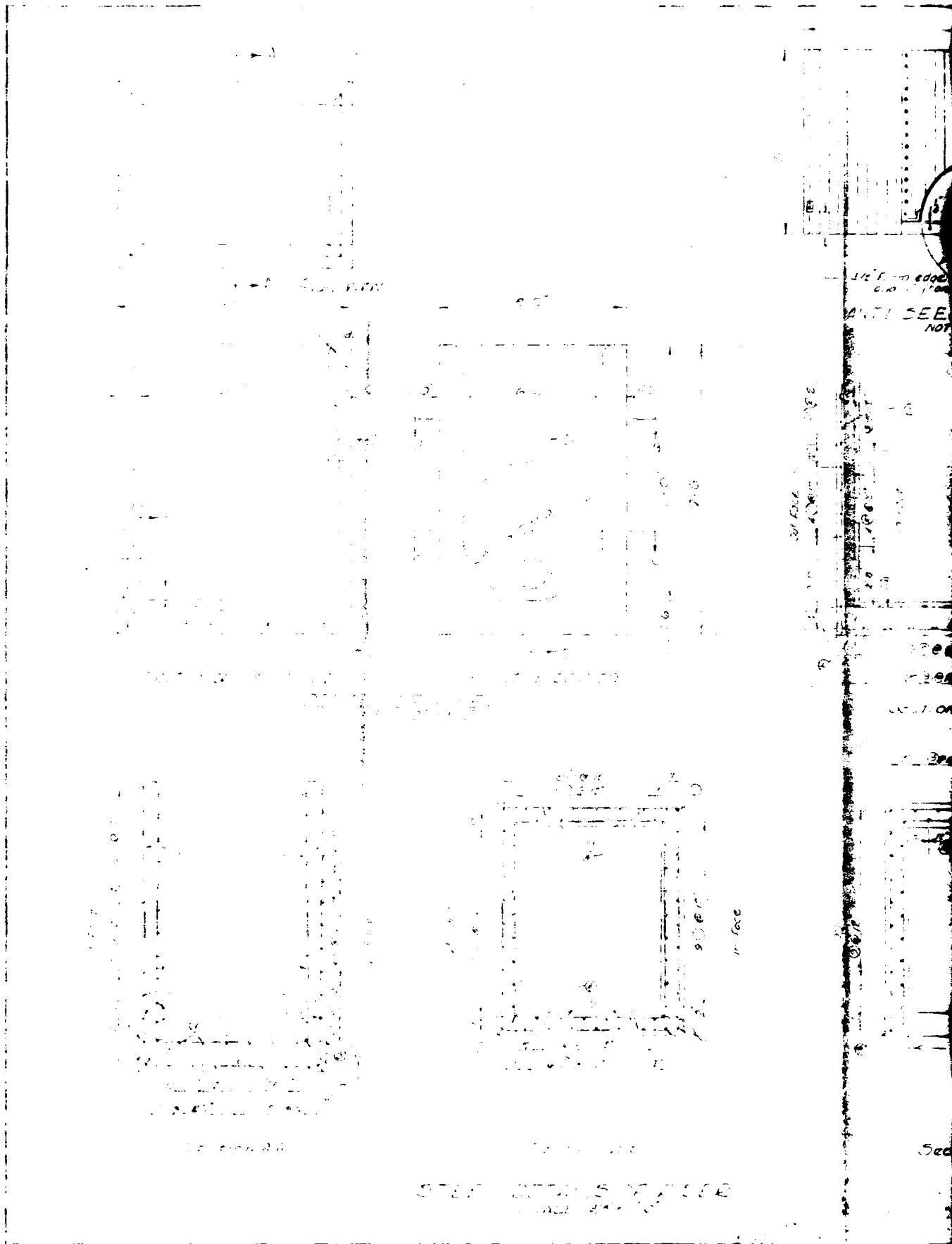
FILE

Estimate of ...
 with all ...
 and ...
 ...
 ...

SCHILLER IRRIGATION ...
 PLATE PROFILE
 ...

U.S. DEPARTMENT OF AGRICULTURE
 SOIL CONSERVATION SERVICE

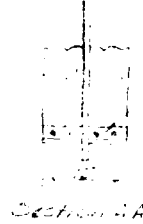
Original	Date	Reviewed by
Working drawing	5/27/34	...
Drawn		
Checked		
Traced		
Notes		
Revised		





1/2" from edge of upper half of dam apron
and 1/2" from edge of lower half

ANTI SEEP COLLAR (12' dia.)
NOT TO SCALE



NOTE
This section is a section of the dam
made of concrete.

NO.	DATE	DESCRIPTION	AMOUNT	TOTAL
1	4-8		216.00	216.00
2	4-10		284.72	500.72
3	4-17		17.00	517.72
4	8-10		11.15	528.87
5	9-7		200.00	728.87
6			330.00	1058.87
7			104.00	1162.87
8			413.30	1576.17
9			1.00	1577.17
10				
11				
12				
13				
14				
15				
16				
17				

FILE

DAM ACTIVITIES

FILE

DAM ACTIVITIES

U.S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE
NATIONAL ENGINEERING CENTER
WASHINGTON, D.C.

APPENDIX A

CHECK LIST - VISUAL OBSERVATIONS

CHECK LIST - ENGINEERING, CONSTRUCTION
MAINTENANCE DATA

CHECK LIST
VISUAL INSPECTION
PHASE 1

Name Dam Schiller Pond Dam County Hunterdon State New Jersey Coordinators NJ-DEP

Date(s) Inspection January 13, 1981 Weather Clear Temperature 0°F
February 3, 1981 Clear 10°F

Pool Elevation at Time of Inspection 305 NGVD Tailwater at Time of Inspection 294.5 NGVD

Inspection Personnel:

January 13, 1981

William Birch
Thomas Moroney
Joseph Sirianni (Recorder)

February 3, 1981

Thomas Moroney

OWNER/REPRESENTATIVE:

January 13, 1981

William Schiller
R.D.I., Box 350
Hopewell, NJ 08525

EMBANKMENT

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS AND RECOMMENDATIONS
SURFACE CRACKS	None noticed.	
UNUSUAL MOVEMENT OR CRACKING AT OR BEYOND THE TOE	None noticed.	
SLOUGHING OR EROSION OF EMBANKMENT AND ABUTMENT SLOPES	Some minor erosion on the downstream slope by the outlet pipe.	
VERTICAL & HORIZONTAL ALIGNMENT OF THE CREST	Horizontal and vertical alignments appear good.	
RIPRAP FAILURES	None	

EMBANKMENT

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS AND RECOMMENDATIONS
EARTH EMBANKMENT	<p>Embankment is grass covered and in good condition. A small clump of evergreen trees growing at the junction of the embankment with the left end of the auxiliary spillway.</p> <p>One small tree growing at edge of the pond left of drop inlet.</p>	Remove trees.
JUNCTION OF EMBANKMENT AND ABUTMENT, SPILLWAY AND DAM	<p>Junction of the embankment with the auxiliary spillway is in good condition.</p>	
ANY NOTICEABLE SEEPAGE	None noticed.	
STAFF GAGE AND RECORDER	None.	
DRAINS	None.	

OUTLET WORKS
OUTLET WORKS

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS AND RECOMMENDATIONS
CRACKING & SPALLING OF CONCRETE SURFACES IN STILLING BASIN		
N/A - Main spillway (also outlet works) discharges directly into the downstream channel. Auxiliary spillway discharges onto existing ground and then into the downstream channel.		
INTAKE STRUCTURE		
Main spillway is concrete drop inlet with a valve and is in good condition.		
N/A - Auxiliary spillway.		
OUTLET STRUCTURE		
A 72-inch corrugated metal pipe in good condition. There is no headwall at outlet end of pipe. Riprap of slope along sides of pipe is missing. There is minor erosion of slope on sides of pipe. Valve was not opened as hand crank was missing. Owner stated valve not used due to pond being stocked with trout.		Provide concrete headwall and apron. Determine if low-level outlet gate is operable.
OUTLET FACILITIES		
None.		
EMERGENCY GATE		
None		

UNGATED SPILLWAY

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS AND RECOMMENDATIONS
CONCRETE WEIR	Main spillway is a concrete drop inlet with a valve. The spillway is in good condition. Auxiliary spillway is a grass channel.	
APPROACH CHANNEL	The pond is the approach channel for both spillways.	
DISCHARGE CHANNEL	Main spillway: 72-inch corrugated metal pipe, in good condition, is the discharge channel and low-level outlet. Auxiliary spillway: Grass covered channel in good condition.	
BRIDGE AND PIERS N/A		

INSTRUMENTATION

VISUAL EXAMINATION OF MONUMENTATION/SURVEYS	OBSERVATIONS	REMARKS AND RECOMMENDATIONS
None.		
OBSERVATION WELLS		
None.		
WEIRS		
None.		
PIEZOMETERS		
None.		
OTHER		
None.		

RESERVOIR

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS AND RECOMMENDATIONS
SLOPES	The slopes are flat to moderate. There are some trees growing along the left shore and a evergreen nursery on the back slope. There is no indication of slope instability.	
SEDIMENTATION	None observed. Pond covered with ice.	

DOWNSTREAM CHANNEL

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS AND RECOMMENDATIONS
CONDITION (OBSTRUCTIONS, DEBRIS, ETC.)	Channel in good condition well define with no debris.	
SLOPES	Slopes of channel are about 2-feet high, steep and wooded. Surrounding area of channel is flat. Minor erosion of right bank just downstream of the outlet pipe.	
APPROXIMATE NUMBER OF HOMES AND POPULATION	There are more than a dozen houses both sides of the downstream channel after it crosses under Rocktown-Lambertville Road approximately 600 feet downstream of the dam.	

CHECK LIST
ENGINEERING DATA
DESIGN, CONSTRUCTION, OPERATION

ITEM	REMARKS
PLAN OF DAM	Available on microfilm at NJ Department of Environmental Protection (NJ-DEP), 1474 Prospect Street, P.O. Box CN-029, Trenton, NJ 08625 Available at U.S. Department of Agriculture Soil Conservation Service (SCS) 1370 Hamilton Street, Somerset, NJ 08873
REGIONAL VICINITY MAP	Available. Hunterdon County Map and U.S.G.S. Quadrangle sheet for Stockton, N.J.
CONSTRUCTION HISTORY	No formal history exists, but can be deduced from available microfilm at NJ-DEP.
TYPICAL SECTIONS OF DAM	Available on microfilm at NJ-DEP and SCS files.
HYDROLOGIC/HYDRAULIC DATA	Limited data available at NJ-DEP and SCS files.
OUTLETS - PLAN	Available on microfilm, NJ-DEP and SCS files.
- DETAILS	Available on microfilm, NJ-DEP and SCS files.
- CONSTRAINTS	None.
- DISCHARGE RATINGS	Not available.
RAINFALL / RESERVOIR RECORDS	Not available.

CHECK LIST
ENGINEERING DATA
DESIGN, CONSTRUCTION, OPERATION
(continued)

ITEM	REMARKS
DESIGN REPORTS	None available.
GEOLOGY REPORTS	Available U.S.G.S. Geologic Overlay Sheet for Hunterdon County and Engineering Soils Survey of New Jersey, Report No. 6 - Hunterdon County, by Rutgers University (New Brunswick, NJ).
DESIGN COMPUTATIONS HYDROLOGY & HYDRAULICS DAM STABILITY SEEPAGE STUDIES	Limited data available on microfilm, NJ-DEP and SCS files. None available.
MATERIALS INVESTIGATIONS BORING RECORDS LABORATORY FIELD	Test pit results available on microfilm, NJ-DEP and SCS files. None available.
POST-CONSTRUCTION SURVEYS OF DAM	None.
BORROW SOURCES	Unknown.
SPILLWAY PLAN - SECTIONS - DETAILS	Available on microfilm, NJ-DEP and SCS files.

CHECK LIST
ENGINEERING DATA
DESIGN, CONSTRUCTION, OPERATION
(continued)

ITEM	REMARKS
OPERATING EQUIPMENT PLANS AND DETAILS	None available.
MONITORING SYSTEMS	None available.
MODIFICATIONS	None
HIGH POOL RECORDS	Not kept.
POST CONSTRUCTION ENGINEERING STUDIES AND REPORTS	None
PRIOR ACCIDENTS OF FAILURE OF DAM - DESCRIPTION -- REPORTS	None known to exist.
MAINTENANCE OPERATION RECORDS	None known to exist.

APPENDIX B

PHOTOGRAPHS

SCHILLER POND DAM



Photo 1 - View of dam taken from right bank of auxiliary spillway. Note clump of trees on embankment in right of photo. (Photo taken on January 13, 1961.)

SCHILLER POND DAM



Photo 2 -View of discharge channel of auxiliary spillway.
(Photo taken on January 13, 1981.)



Photo 3 - View of downstream slope looking towards left
end of dam. Note low-level outlet pipe in the
lower right. (Photo taken on February 3, 1981.)

SCHILLER POND DAM



Photo 4 - View of upstream slope of dam looking towards the right end. (Photo taken on January 13, 1981.)



Photo 5 - View of drop inlet (main spillway) and pond from the top of the embankment. (Photo taken on January 13, 1981.)

SCHILLER POND DAM



Photo 6 - View of downstream channel and outlet pipe from top of the embankment. (Photo taken on January 13, 1981.)



Photo 7 - View of 72-inch C.M.P. outlet pipe. Note minor erosion on sides of pipe. (Photo taken on February 3, 1981.)

SCHILLER POND DAM



Photo 8 - View of downstream channel crossing under Rocktown-Lambertville Road. (Photo taken on January 13, 1981.)



Photo 9 - View of channel and houses downstream from Rocktown-Lambertville Road. (Photo taken on January 13, 1981.)

APPENDIX C

SUMMARY OF ENGINEERING DATA

CHECK LIST
HYDROLOGIC AND HYDRAULIC DATA
ENGINEERING DATA

Name of Dam: SCHILLER POND DAM

Drainage Area Characteristics: 1.4 square miles

Elevation Top Normal Pool (Storage Capacity): 305 NGVD (18 acre-feet)

Elevation Top Flood Control Pool (Storage Capacity): N/A

Elevation Maximum Design Pool: 312.3 NGVD (SDF pool-83 acre-feet)

Elevation Top Dam: 311.5 NGVD (73 acre-feet)

SPILLWAY CREST:

a. Elevation	Main:	305 NGVD
	Auxiliary:	307.5 NGVD
b. Type	Main:	Concrete drop inlet
	Auxiliary:	Natural channel
c. Width	Main:	10 feet
	Auxiliary:	20 feet
d. Length	Main:	28 feet
	Auxiliary:	60 feet
e. Location Spillover	Entire length	
f. No. and Type of Gates	None	

OUTLET WORKS:

a. Type	<u>72-inch C.M.P.</u>
b. Location	<u>Upstream face of spillway</u>
c. Entrance Inverts	<u>294.5 NGVD</u>
d. Exit Inverts	<u>294.0 NGVD</u>
e. Emergency Draindown Facilities	<u>18-inch valve 72-inch C.M.P.</u>

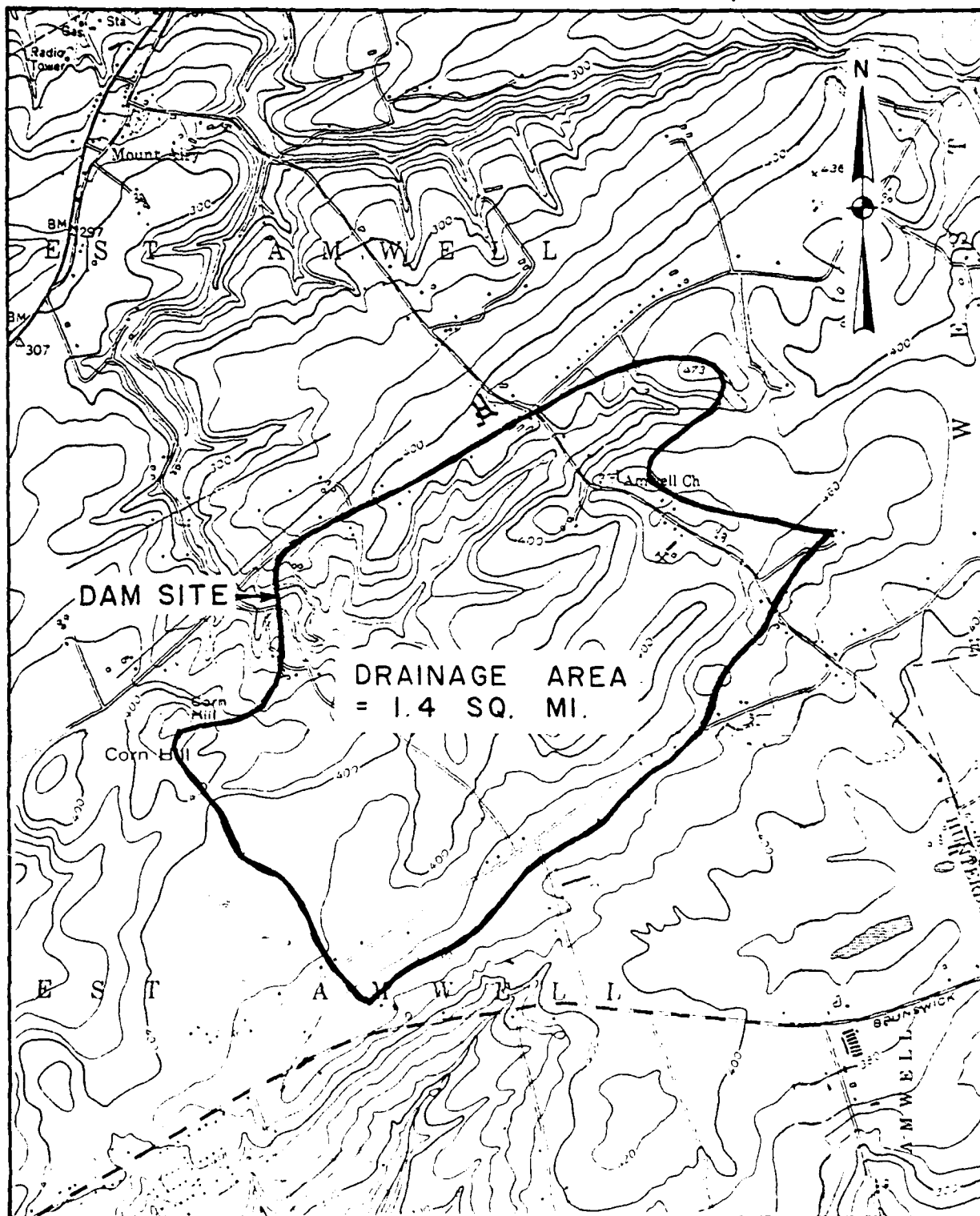
HYDROMETEOROLOGICAL GAGES:

a. Type	<u>None</u>
b. Location	<u>None</u>
c. Records	<u>None</u>

MAXIMUM NON-DAMAGING DISCHARGE: 2,207 cfs at elevation 311.5 NGVD

APPENDIX D

HYDROLOGIC COMPUTATIONS



2,000 0 2,000 4,000

Scale: 1" = 2,000 FT.

SCHILLER POND DAM
DRAINAGE BASIN

PRC Harris, Inc.
CONSULTING ENGINEERS

SUBJECT N.I. Dam Inspection
Schiller Pond Dam
COMPUTED BY S.B. CHECKED BY _____

SHEET NO. 1 OF _____
JOB NO. 10-1176-01
DATE Feb, 1981

Area of the Lake at normal pool level.

(Area measured from U.S.G.S Quad
at El = 305.0 = 5.5 Ac.

Height of the Dam = 18.5 FT
(From File)

Small Dam, High Hazard

S.D.F. = $\frac{1}{2}$ PMF

Hydrologic analysis: -

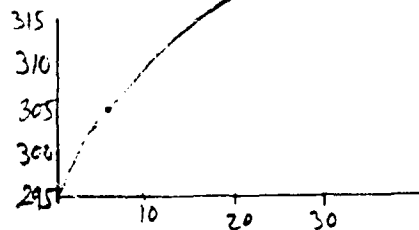
D.A. = 1.37 sq. miles

Inflow Hydrograph at Reservoir was determined
using HEC 1 DB program. Inflow routed
through the reservoir

Elevation Area Capacity Relationship

Information obtained from U.S.G.S

Elevation	294	305	320
Surface area (Ac)	0	5.5	23.4



HEC - 1 DB program with elevation

Storage capacity from surface area - elevation.

Determination of PMP

Probable Maximum ppt. (inches) for an area of
10 square miles and 6 hour duration
= 26"

D.A = 1.37 sq miles

ZONE = 6

The Corps of Engineers recommended that
20 % reduction to be applied to the
report value for a 10 sq miles drainage
area in order to provide for the imperfect
fit of the storm isohyetal patterns to the
shape of the particular basin.

Because of the unlikelihood of a perfect
strike of a storm center on any particular
small basin, no variation is assumed between
point and 10 square miles precipitation

P.M.P. = $26" \times (1 - 0.2) = 20.8"$ (this adjustment
is made by the computer)

Depth area duration relationship.

Percentage to be applied to the above 6 hr PMP

6 hr = 100 %

12 hr = 108 %

24 hr = 117 %

48 hr = 127 % (Not necessary)

Infiltration: Initial = 1.0 inch

const. infiltration = 0.1 inch/hr

DETERMINATION OF T_c

1. Estimating T_c from velocity estimate and Watershed length (Ref. Design of Small Dam: Fig 30)

	Slope	Vel	Remarks
Overland Flow	$\frac{473-360}{2400} \times 100 = 4.7\%$	3 ft/sec	Upper portion of watershed
Reach 1	$\frac{360-305}{2950} \times 100 = 1.9\%$	1.5 ft/sec	Natural channel not well defined (Lake excluded)

$$T_c = \frac{2400}{3 \times 3600} + \frac{2950}{1 \times 3600} = 1.04 \text{ hrs.}$$

2. Estimating T_c assuming same vel of 1.5 ft/sec

$$T_c = \frac{5350}{1.5 \times 3600} = 0.99 \text{ hrs}$$

3. From Nomograph of design of Small Dam (S.C.S. Guide) — Same as Kirpich

$$T_c = \left(\frac{11.9 L^3}{H} \right)^{.385} \quad \begin{array}{l} L \text{ in miles} = 1.01 \text{ miles} \\ \text{(Lake excluded)} \\ H = 168 \text{ Ft.} \end{array}$$

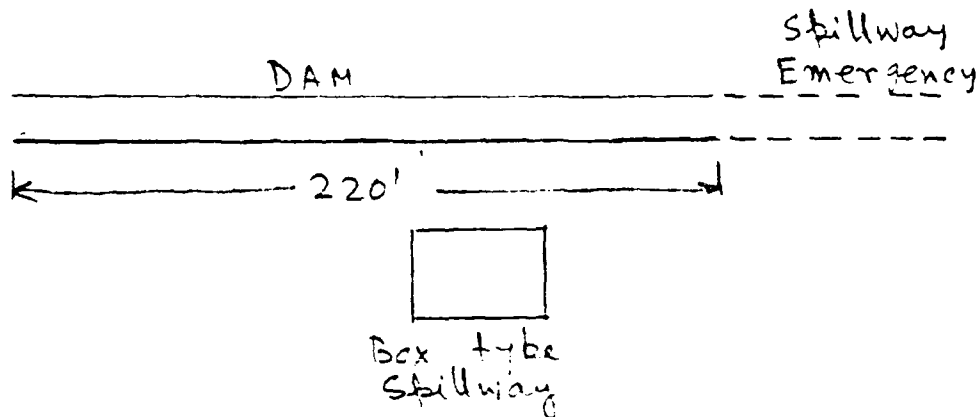
$$= \left(\frac{11.9 \times 1.01^3}{168} \right)^{.385}$$

$$= .36 \text{ Hrs.}$$

Use $T_c = 1 \text{ hrs.}$

$$\text{Lag} = .6 T_c = .6 \times 1 = 0.6 \text{ hrs.}$$

DAM & SPILLWAY



Water entering through all four sides of the spillway.

✓ Total length of spillway main = 28'

✓ Elevation = 305.0 Ft MSL

Elevation shown in S.C.S drawing are added with 202 ft to get the actual elevation comparable to U.S.G.S.

✓ Total effective length of emergency spillway = 60'

✓ Elevation of Aux. Spillway = 307.4 Ft MSL

✓ Length of Dam = 220'

✓ Ave. El of Dam = 311.5 Ft MSL

Outlet 6' d pipe

Drop inlet spillway :-

$$\text{Eff. length} = 26'$$

$$Q_s = C_s L_s H_s^{1.5} = 3.3 \times 26 H_s^{1.5} = 92.4 H_s^{1.5}$$

Considering flow through the tube (6' ϕ)

$$\begin{aligned} Q_o &= C_d \cdot A_o \cdot \sqrt{2g H_o} \\ &= 0.63 \left(\frac{\pi}{4} \times 6^2 \right) \times \sqrt{2} \sqrt{H_o} \\ &= 143 \sqrt{H_o} \end{aligned}$$

Where H_o = Difference of elevation between
 H.W. and T.W.

Tailwater assumed to be = 296 Ft MSL

Invert of the pipe 294 Ft MSL.

Res. El	Head over Spillway HS	& Through Spillway $92.4 H_s^{1.5}$	Head for Orifice Flow H_o	Flow thro' orifice $Q_o = 143 \sqrt{H_o}$	
305	-	0	-	-	
306	1	92.4	10	452	
307.4	2.4	343	11.4	482	
309	4	739	13	515	
311.5	6.5		15.5	563	
313	8		17	590	
315	10		19	623	
317	12		21	655	
319	14		23	686	
321	16		25	715	
325	20		29	770	

Flow
Controlled
by pipe.

Stage Outflow relationship :-

① Flow through Drop inlet Q_D (Stillway)

② Flow through Emergency Spillway

$$Q_A = 3.3 L_A H_A^{1.5}$$

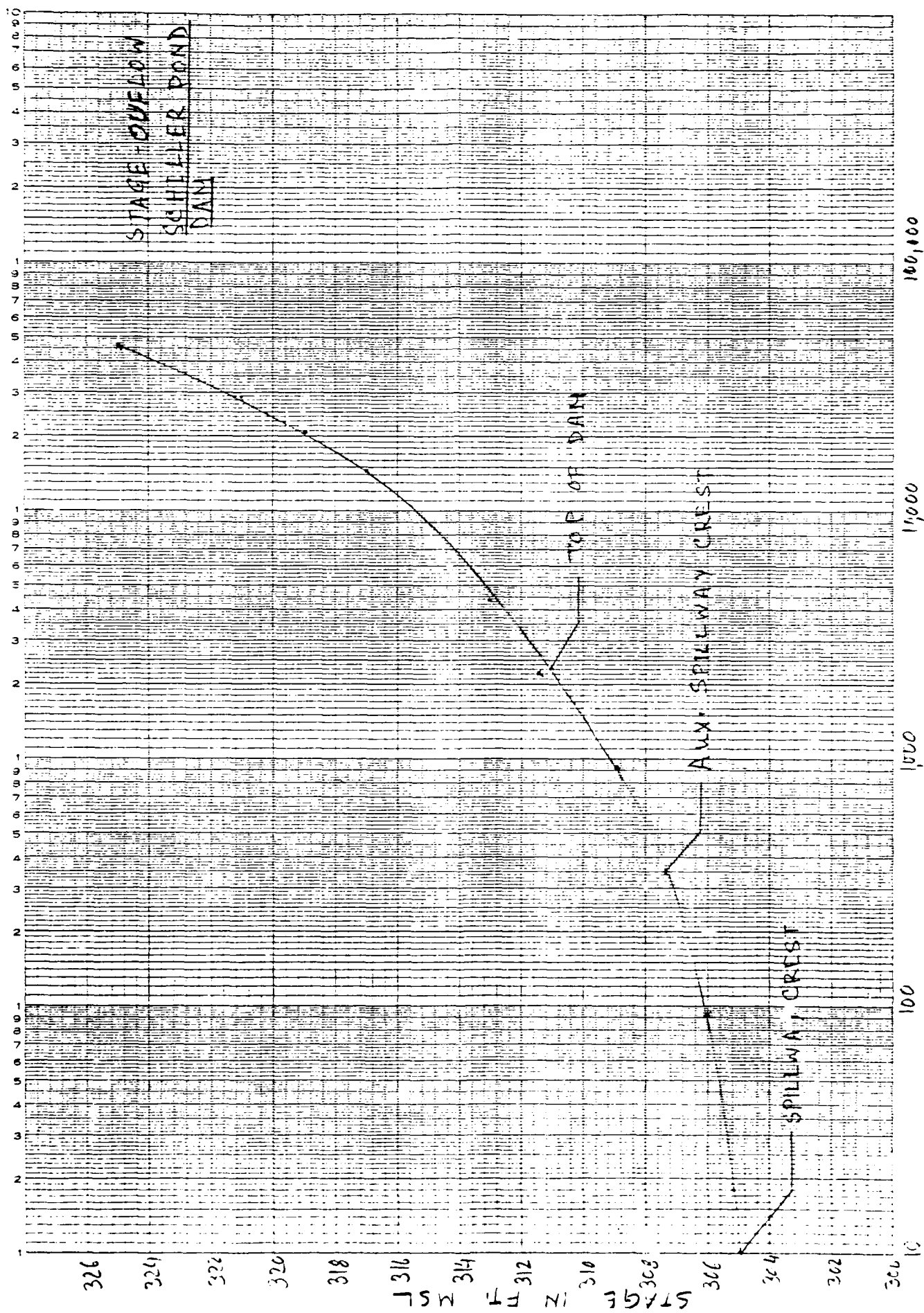
$$= 3.3 \times 60 H_A^{1.5} = 198 H_A^{1.5}$$

③ Flow through Dam

$$Q_D = 2.75 L_D H_D^{1.5}$$

$$= 2.75 \times 220 H_D^{1.5} = 605 H_D^{1.5}$$

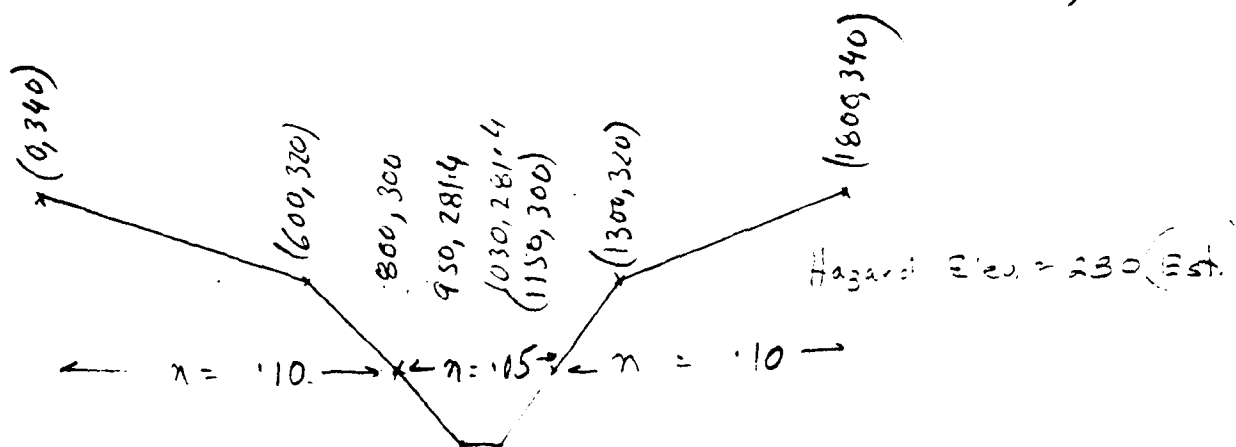
Stage in Reservoir	Spillway Q _D	Emergency Spillway		DAM		Q Total
		H _A	Q _A 198 H _A ^{1.5}	H _D	Q _D 605 H _D ^{1.5}	
305	0					0
306	92					92
307.4	343	0	0			343
309	515	1.6	400			915
311.5	563	4.1	1,644	0	0	2,207
313	590	5.6	2,624	1.5	1,111	4,325
315	623	7.6	4,149	3.5	3,961	8,133
317	655	9.6	5,889	5.5	7,804	14,348
319	686	11.6	7,823	7.5	12,426	20,935
321	715	13.6	9,931	9.5	17,715	28,361
325	770	17.6	14,620	13.5	30,009	45,399



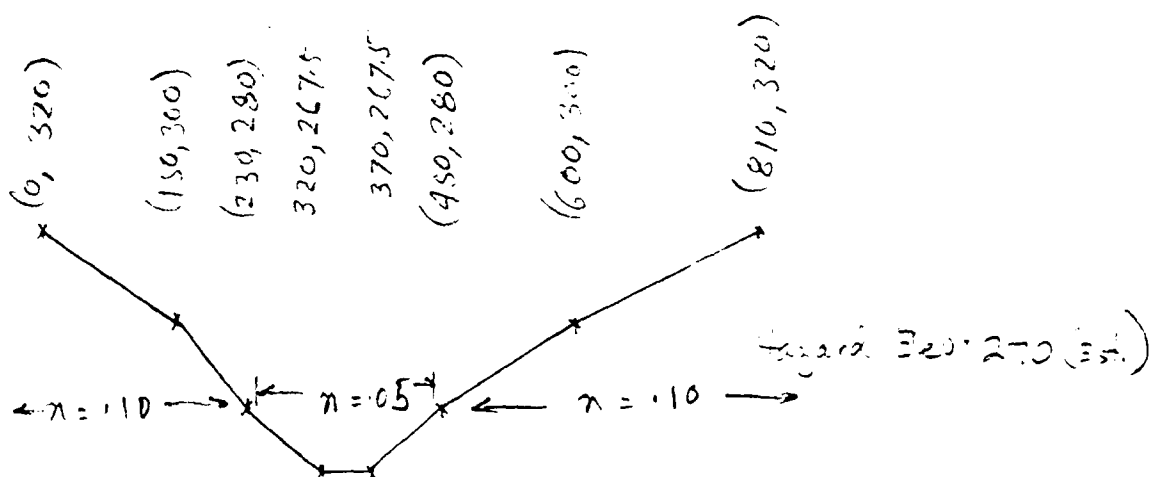
PRC Harris, Inc.
CONSULTING ENGINEERS

SUBJECT N.J. Dam Inspection
Schiller Pond Dam
COMPUTED BY S.B. CHECKED BY _____

SHEET NO. 8 OF _____
JOB NO. 10-1174-C1
DATE Feb, 1981



Reach 1 : $L = 800 \text{ Ft}$
 $S = .0095$



Reach 2 : $L = 2,000 \text{ Ft}$ Length of Reach
 $S = .0125$ = 1,200

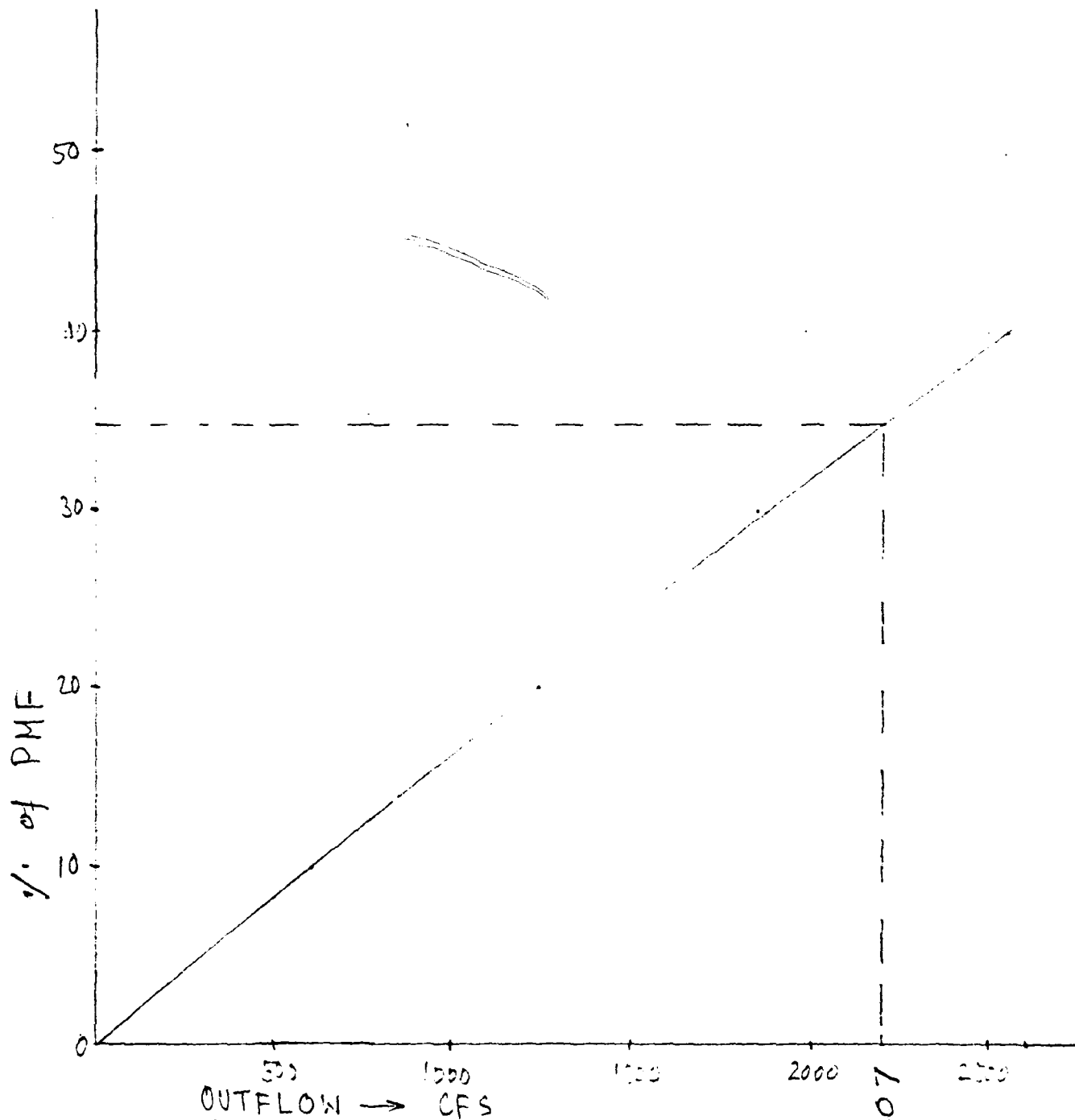
CROSS SECTION AT D/S REACH

PRC Harris, Inc.
CONSULTING ENGINEERS

SUBJECT N.I. Dam Inspection
Schiller Pond Dam
COMPUTED BY S.D. CHECKED BY _____

SHEET NO. 9 OF _____
JOB NO. 15-1176-C1
DATE Feb, 1981

Overtopping Potential



Overtopping of Dam occurs at El 311.5

$Q = 2207$ (35% of PMF)

PRC Harris, Inc.
CONSULTING ENGINEERS

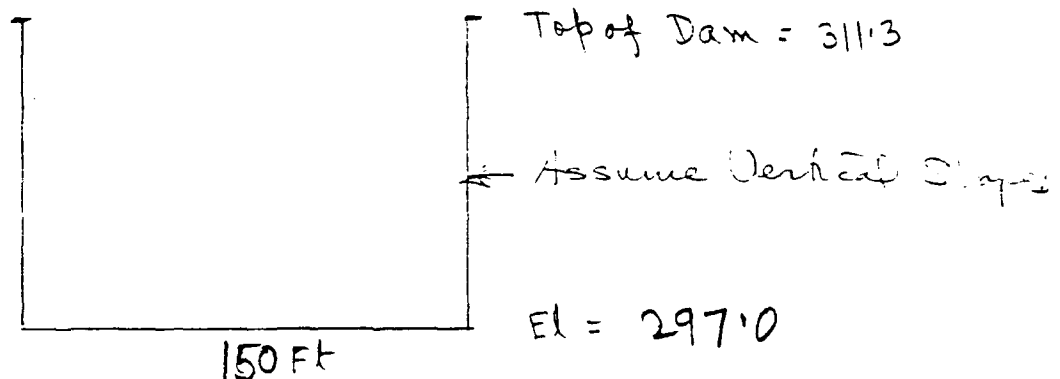
SUBJECT N.J. Dam Inspection
Schiller Pond Dam
COMPUTED BY S.B. CHECKED BY _____

SHEET NO. 10 OF _____
JOB NO. 12-1176-01
DATE Feb, 1981

BREACH ANALYSIS

Assume breach begins to develop when reservoir stage reaches above the dam

Time of Failure II = 16.25 hrs.



Effect of breach was analysed at 800 ft D/S of Dam

Max. Stage without Dam break = 285.1

Max. Stage with Dam break = 285.7.

0.6 feet increase @ 0.4 PMP

Effect of breach was also analysed at 2000 ft D/S

Max. Stage without Dam break = 271.7

Max. Stage with Dam break = 272.5

There will be 0.8 FT increase in stage due to Dam break at 0.4 PMP

PRC Harris, Inc.
CONSULTING ENGINEERS

SUBJECT N.J. Dam Inspection
Schiller Pond Dam
COMPUTED BY S.B. CHECKED BY _____

SHEET NO. 11 OF _____
JOB NO. 1176-C.1
DATE Feb, 1981

Drawdown time Computation

_____ 7 _____ El = 305

When the gate is open
Normal elevation to
Start = 305.0

$$Inflow = \frac{2.44}{mi^2} \times 1.37 = 374$$

(184) _____ 299.5

$$Q = CA \sqrt{2gh} \quad C = 0.62$$

$$A = \frac{\pi}{4} \times 15^2$$

$$= 8.8 \sqrt{h}$$

Assume Tailwater Elev. = 299.5 FT

$$A_2 = \left(\frac{h_2}{h_1} \right)^2 A_1 = \left(\frac{h_2}{11} \right)^2 \times 5.5 = 1045 h_2^2$$

$A_1 = 5.5$
 $h_1 = 11$

$$Drawdown time = \frac{Vol in AF \times 43560}{Q \times 3600} = 12.1 \frac{Vol}{Q}$$

EL	Area	AVG Area	Vol	AVG head h	Q 8.8 \sqrt{h}	Drawdown Time $\frac{Vol \times 12.1}{Q}$	Cum time	Drawdown with inflow $\frac{2.74 \times t}{Q \text{ HRS}}$	Cum time
FT	Ac	Ac	AF	FT	CFS	hrs	HRS	& HRS	HRS
305	5.5								
		5.0	5.0	5	19.7	3.07	3.07	.43	3.5
304	4.5								
		4.06	4.06	4	17.6	2.31	5.88	.44	6.75
303	3.65								
		3.27	3.27	3	15.2	2.60	8.48	.47	9.82
302	2.88								
		2.54	2.54	2	12.4	2.56	11.04	.57	12.95
301	2.20								
		1.91	1.91	1	8.8	2.71	13.75	.60	16.15
300	1.62								
		1.47	1.75	1.25	4.4	2.03	15.88	.62	19.95
299.5	1.36								

Time of drawdown without inflow = 15.88 \approx 16 hrs.
Time of drawdown with const. inflow = 20 hrs.

PLANS FIGURE 20 - SUMMARY OF RESULTS FOR MULTIPLE PLAN-RATIO ECONOMIC COMPUTATIONS
 FLOW IN CUBIC FEET PER SECOND (CFS) (CUMULATIVE METERS PER SECOND)
 AREA IN SQUARE FEET (SQUARE KILOMETERS)

STATION		AREA	PLAN RATIO	1 RATIO	2 RATIO	3 RATIO	4 RATIO	5 RATIO
				0.50	0.60	0.70	0.80	0.90
FROM	TO							
1	2	1.57	1.57	1.57	1.57	1.57	1.57	1.57
2	3	3.50	3.50	3.50	3.50	3.50	3.50	3.50
3	4	1.57	1.57	1.57	1.57	1.57	1.57	1.57
4	5	3.50	3.50	3.50	3.50	3.50	3.50	3.50
5	6	1.57	1.57	1.57	1.57	1.57	1.57	1.57
6	7	3.50	3.50	3.50	3.50	3.50	3.50	3.50
7	8	1.57	1.57	1.57	1.57	1.57	1.57	1.57
8	9	3.50	3.50	3.50	3.50	3.50	3.50	3.50
9	10	1.57	1.57	1.57	1.57	1.57	1.57	1.57
10	11	3.50	3.50	3.50	3.50	3.50	3.50	3.50
11	12	1.57	1.57	1.57	1.57	1.57	1.57	1.57
12	13	3.50	3.50	3.50	3.50	3.50	3.50	3.50
13	14	1.57	1.57	1.57	1.57	1.57	1.57	1.57
14	15	3.50	3.50	3.50	3.50	3.50	3.50	3.50
15	16	1.57	1.57	1.57	1.57	1.57	1.57	1.57
16	17	3.50	3.50	3.50	3.50	3.50	3.50	3.50
17	18	1.57	1.57	1.57	1.57	1.57	1.57	1.57
18	19	3.50	3.50	3.50	3.50	3.50	3.50	3.50
19	20	1.57	1.57	1.57	1.57	1.57	1.57	1.57
20	21	3.50	3.50	3.50	3.50	3.50	3.50	3.50
21	22	1.57	1.57	1.57	1.57	1.57	1.57	1.57
22	23	3.50	3.50	3.50	3.50	3.50	3.50	3.50
23	24	1.57	1.57	1.57	1.57	1.57	1.57	1.57
24	25	3.50	3.50	3.50	3.50	3.50	3.50	3.50
25	26	1.57	1.57	1.57	1.57	1.57	1.57	1.57
26	27	3.50	3.50	3.50	3.50	3.50	3.50	3.50
27	28	1.57	1.57	1.57	1.57	1.57	1.57	1.57
28	29	3.50	3.50	3.50	3.50	3.50	3.50	3.50
29	30	1.57	1.57	1.57	1.57	1.57	1.57	1.57
30	31	3.50	3.50	3.50	3.50	3.50	3.50	3.50
31	32	1.57	1.57	1.57	1.57	1.57	1.57	1.57
32	33	3.50	3.50	3.50	3.50	3.50	3.50	3.50
33	34	1.57	1.57	1.57	1.57	1.57	1.57	1.57
34	35	3.50	3.50	3.50	3.50	3.50	3.50	3.50
35	36	1.57	1.57	1.57	1.57	1.57	1.57	1.57
36	37	3.50	3.50	3.50	3.50	3.50	3.50	3.50
37	38	1.57	1.57	1.57	1.57	1.57	1.57	1.57
38	39	3.50	3.50	3.50	3.50	3.50	3.50	3.50
39	40	1.57	1.57	1.57	1.57	1.57	1.57	1.57
40	41	3.50	3.50	3.50	3.50	3.50	3.50	3.50
41	42	1.57	1.57	1.57	1.57	1.57	1.57	1.57
42	43	3.50	3.50	3.50	3.50	3.50	3.50	3.50
43	44	1.57	1.57	1.57	1.57	1.57	1.57	1.57
44	45	3.50	3.50	3.50	3.50	3.50	3.50	3.50
45	46	1.57	1.57	1.57	1.57	1.57	1.57	1.57
46	47	3.50	3.50	3.50	3.50	3.50	3.50	3.50
47	48	1.57	1.57	1.57	1.57	1.57	1.57	1.57
48	49	3.50	3.50	3.50	3.50	3.50	3.50	3.50
49	50	1.57	1.57	1.57	1.57	1.57	1.57	1.57
50	51	3.50	3.50	3.50	3.50	3.50	3.50	3.50
51	52	1.57	1.57	1.57	1.57	1.57	1.57	1.57
52	53	3.50	3.50	3.50	3.50	3.50	3.50	3.50
53	54	1.57	1.57	1.57	1.57	1.57	1.57	1.57
54	55	3.50	3.50	3.50	3.50	3.50	3.50	3.50
55	56	1.57	1.57	1.57	1.57	1.57	1.57	1.57
56	57	3.50	3.50	3.50	3.50	3.50	3.50	3.50
57	58	1.57	1.57	1.57	1.57	1.57	1.57	1.57
58	59	3.50	3.50	3.50	3.50	3.50	3.50	3.50
59	60	1.57	1.57	1.57	1.57	1.57	1.57	1.57
60	61	3.50	3.50	3.50	3.50	3.50	3.50	3.50
61	62	1.57	1.57	1.57	1.57	1.57	1.57	1.57
62	63	3.50	3.50	3.50	3.50	3.50	3.50	3.50
63	64	1.57	1.57	1.57	1.57	1.57	1.57	1.57
64	65	3.50	3.50	3.50	3.50	3.50	3.50	3.50
65	66	1.57	1.57	1.57	1.57	1.57	1.57	1.57
66	67	3.50	3.50	3.50	3.50	3.50	3.50	3.50
67	68	1.57	1.57	1.57	1.57	1.57	1.57	1.57
68	69	3.50	3.50	3.50	3.50	3.50	3.50	3.50
69	70	1.57	1.57	1.57	1.57	1.57	1.57	1.57
70	71	3.50	3.50	3.50	3.50	3.50	3.50	3.50
71	72	1.57	1.57	1.57	1.57	1.57	1.57	1.57
72	73	3.50	3.50	3.50	3.50	3.50	3.50	3.50
73	74	1.57	1.57	1.57	1.57	1.57	1.57	1.57
74	75	3.50	3.50	3.50	3.50	3.50	3.50	3.50
75	76	1.57	1.57	1.57	1.57	1.57	1.57	1.57
76	77	3.50	3.50	3.50	3.50	3.50	3.50	3.50
77	78	1.57	1.57	1.57	1.57	1.57	1.57	1.57
78	79	3.50	3.50	3.50	3.50	3.50	3.50	3.50
79	80	1.57	1.57	1.57	1.57	1.57	1.57	1.57
80	81	3.50	3.50	3.50	3.50	3.50	3.50	3.50
81	82	1.57	1.57	1.57	1.57	1.57	1.57	1.57
82	83	3.50	3.50	3.50	3.50	3.50	3.50	3.50
83	84	1.57	1.57	1.57	1.57	1.57	1.57	1.57
84	85	3.50	3.50	3.50	3.50	3.50	3.50	3.50
85	86	1.57	1.57	1.57	1.57	1.57	1.57	1.57
86	87	3.50	3.50	3.50	3.50	3.50	3.50	3.50
87	88	1.57	1.57	1.57	1.57	1.57	1.57	1.57
88	89	3.50	3.50	3.50	3.50	3.50	3.50	3.50
89	90	1.57	1.57	1.57	1.57	1.57	1.57	1.57
90	91	3.50	3.50	3.50	3.50	3.50	3.50	3.50
91	92	1.57	1.57	1.57	1.57	1.57	1.57	1.57
92	93	3.50	3.50	3.50	3.50	3.50	3.50	3.50
93	94	1.57	1.57	1.57	1.57	1.57	1.57	1.57
94	95	3.50	3.50	3.50	3.50	3.50	3.50	3.50
95	96	1.57	1.57	1.57	1.57	1.57	1.57	1.57
96	97	3.50	3.50	3.50	3.50	3.50	3.50	3.50
97	98	1.57	1.57	1.57	1.57	1.57	1.57	1.57
98	99	3.50	3.50	3.50	3.50	3.50	3.50	3.50
99	100	1.57	1.57	1.57	1.57	1.57	1.57	1.57

COMPUTATION OF DAM SAFETY ANALYSIS

EXISTING VALUE CHILLIAY PREST TOP OF DAM
 305.00 311.50
 1.5 13.
 0. 2207.

MINIMUM	MAXIMUM	OUTFLOW	DURATION	TIME OF	TIME OF
FEET	FEET	CS	HOURS	MAX OUTFLOW	FAILURE
312.00	312.00	332.4	1.00	16.25	0.00
311.7	311.7	355.1	0.50	17.50	0.00
311.01	311.01	382.2	0.00	18.50	0.00
310.64	310.64	414.4	0.00	19.50	0.00
310.17	310.17	451.6	0.00	20.50	0.00

STATION REACH

MINIMUM	MAXIMUM	TIME
FEET	FEET	HOURS
310.50	310.50	16.50
310.00	310.00	16.50
309.50	309.50	16.50
309.00	309.00	16.50
308.50	308.50	16.50

STATION REACH

MINIMUM	MAXIMUM	TIME
FEET	FEET	HOURS
310.50	310.50	16.50
310.00	310.00	16.50
309.50	309.50	16.50
309.00	309.00	16.50
308.50	308.50	16.50

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60	61	62	63	64	65	66	67	68	69	70	71	72	73	74	75	76	77	78	79	80	81	82	83	84	85	86	87	88	89	90	91	92	93	94	95	96	97	98	99	100	101	102	103	104	105	106	107	108	109	110	111	112	113	114	115	116	117	118	119	120	121	122	123	124	125	126	127	128	129	130	131	132	133	134	135	136	137	138	139	140	141	142	143	144	145	146	147	148	149	150	151	152	153	154	155	156	157	158	159	160	161	162	163	164	165	166	167	168	169	170	171	172	173	174	175	176	177	178	179	180	181	182	183	184	185	186	187	188	189	190	191	192	193	194	195	196	197	198	199	200	201	202	203	204	205	206	207	208	209	210	211	212	213	214	215	216	217	218	219	220	221	222	223	224	225	226	227	228	229	230	231	232	233	234	235	236	237	238	239	240	241	242	243	244	245	246	247	248	249	250	251	252	253	254	255	256	257	258	259	260	261	262	263	264	265	266	267	268	269	270	271	272	273	274	275	276	277	278	279	280	281	282	283	284	285	286	287	288	289	290	291	292	293	294	295	296	297	298	299	300	301	302	303	304	305	306	307	308	309	310	311	312	313	314	315	316	317	318	319	320	321	322	323	324	325	326	327	328	329	330	331	332	333	334	335	336	337	338	339	340	341	342	343	344	345	346	347	348	349	350	351	352	353	354	355	356	357	358	359	360	361	362	363	364	365	366	367	368	369	370	371	372	373	374	375	376	377	378	379	380	381	382	383	384	385	386	387	388	389	390	391	392	393	394	395	396	397	398	399	400	401	402	403	404	405	406	407	408	409	410	411	412	413	414	415	416	417	418	419	420	421	422	423	424	425	426	427	428	429	430	431	432	433	434	435	436	437	438	439	440	441	442	443	444	445	446	447	448	449	450	451	452	453	454	455	456	457	458	459	460	461	462	463	464	465	466	467	468	469	470	471	472	473	474	475	476	477	478	479	480	481	482	483	484	485	486	487	488	489	490	491	492	493	494	495	496	497	498	499	500	501	502	503	504	505	506	507	508	509	510	511	512	513	514	515	516	517	518	519	520	521	522	523	524	525	526	527	528	529	530	531	532	533	534	535	536	537	538	539	540	541	542	543	544	545	546	547	548	549	550	551	552	553	554	555	556	557	558	559	560	561	562	563	564	565	566	567	568	569	570	571	572	573	574	575	576	577	578	579	580	581	582	583	584	585	586	587	588	589	590	591	592	593	594	595	596	597	598	599	600	601	602	603	604	605	606	607	608	609	610	611	612	613	614	615	616	617	618	619	620	621	622	623	624	625	626	627	628	629	630	631	632	633	634	635	636	637	638	639	640	641	642	643	644	645	646	647	648	649	650	651	652	653	654	655	656	657	658	659	660	661	662	663	664	665	666	667	668	669	670	671	672	673	674	675	676	677	678	679	680	681	682	683	684	685	686	687	688	689	690	691	692	693	694	695	696	697	698	699	700	701	702	703	704	705	706	707	708	709	710	711	712	713	714	715	716	717	718	719	720	721	722	723	724	725	726	727	728	729	730	731	732	733	734	735	736	737	738	739	740	741	742	743	744	745	746	747	748	749	750	751	752	753	754	755	756	757	758	759	760	761	762	763	764	765	766	767	768	769	770	771	772	773	774	775	776	777	778	779	780	781	782	783	784	785	786	787	788	789	790	791	792	793	794	795	796	797	798	799	800	801	802	803	804	805	806	807	808	809	810	811	812	813	814	815	816	817	818	819	820	821	822	823	824	825	826	827	828	829	830	831	832	833	834	835	836	837	838	839	840	841	842	843	844	845	846	847	848	849	850	851	852	853	854	855	856	857	858	859	860	861	862	863	864	865	866	867	868	869	870	871	872	873	874	875	876	877	878	879	880	881	882	883	884	885	886	887	888	889	890	891	892	893	894	895	896	897	898	899	900	901	902	903	904	905	906	907	908	909	910	911	912	913	914	915	916	917	918	919	920	921	922	923	924	925	926	927	928	929	930	931	932	933	934	935	936	937	938	939	940	941	942	943	944	945	946	947	948	949	950	951	952	953	954	955	956	957	958	959	960	961	962	963	964	965	966	967	968	969	970	971	972	973	974	975	976	977	978	979	980	981	982	983	984	985	986	987	988	989	990	991	992	993	994	995	996	997	998	999	1000
1.01	1.01	1.01	1.01	1.01	1.01	1.01	1.01	1.01	1.01	1.01	1.01	1.01	1.01	1.01	1.01	1.01	1.01	1.01	1.01	1.01	1.01	1.01	1.01	1.01	1.01	1.01	1.01	1.01	1.01	1.01	1.01	1.01	1.01	1.01	1.01	1.01	1.01	1.01	1.01	1.01	1.01	1.01	1.01	1.01	1.01	1.01	1.01	1.01	1.01	1.01	1.01	1.01	1.01	1.01	1.01	1.01	1.01	1.01	1.01	1.01	1.01	1.01	1.01	1.01	1.01	1.01	1.01	1.01	1.01	1.01	1.01	1.01	1.01	1.01	1.01	1.01	1.01	1.01	1.01	1.01	1.01	1.01	1.01	1.01	1.01	1.01	1.01	1.01	1.01	1.01	1.01	1.01	1.01	1.01	1.01	1.01	1.01	1.01	1.01	1.01	1.01	1.01	1.01	1.01	1.01	1.01	1.01	1.01	1.01	1.01	1.01	1.01	1.01	1.01	1.01	1.01	1.01	1.01	1.01	1.01	1.01	1.01	1.01	1.01	1.01	1.01	1.01	1.01	1.01	1.01	1.01	1.01	1.01	1.01	1.01	1.01	1.01	1.01	1.01	1.01	1.01	1.01	1.01	1.01	1.01	1.01	1.01	1.01	1.01	1.01	1.01	1.01	1.01	1.01	1.01	1.01	1.01	1.01	1.01	1.01	1.01	1.01	1.01	1.01	1.01	1.01	1.01	1.01	1.01	1.01	1.01	1.01	1.01	1.01	1.01	1.01	1.01	1.01	1.01	1.01	1.01	1.01	1.01	1.01	1.01	1.01	1.01	1.01	1.01	1.01	1.01	1.01	1.01	1.01	1.01	1.01	1.01	1.01	1.01	1.01	1.01	1.01	1.01	1.01	1.01	1.01	1.01	1.01	1.01	1.01	1.01	1.01	1.01	1.01	1.01	1.01	1.01	1.01	1.01	1.01	1.01	1.01	1.01	1.01	1.01	1.01	1.01	1.01	1.01	1.01	1.01	1.01	1.01	1.01	1.01	1.01	1.01	1.01	1.01	1.01	1.01	1.01	1.01	1.01	1.01	1.01	1.01	1.01	1.01	1.01	1.01	1.01	1.01	1.01	1.01	1.01	1.01	1.01	1.01	1.01	1.01	1.01	1.01	1.01	1.01	1.01	1.01	1.01	1.01	1.01	1.01	1.01	1.01	1.01	1.01	1.01	1.01	1.01	1.01	1.01	1.01	1.01	1.01	1.01	1.01	1.01	1.01	1.01	1.01	1.01	1.01	1.01	1.01	1.01	1.01	1.01	1.01	1.01	1.01	1.01	1.01	1.01	1.01	1.01	1.01	1.01	1.01	1.01	1.01	1.01	1.01	1.01	1.01	1.01	1.01	1.01	1.01	1.01	1.01	1.01	1.01	1.01	1.01	1.01	1.01	1.01	1.01	1.01	1.01	1.01	1.01	1.01	1.01	1.01	1.01	1.01	1.01	1.01	1.01	1.01	1.01	1.01	1.01	1.01	1.																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																														

STANDARD AND CONCENTRATION OF THE SUBSTANCE FOR MULTIPLE PLAN-RATIO ECONOMIC COMPUTATIONS
FLOW, IN CU FT PER SECOND (CUBIC METERS PER SECOND)
AREA, IN SQUARE MILES (SQUARE KILOMETERS)